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THE CANADIAN JOURNAL.

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NOTE ON STELLIFORM CRYSTALS, WITH SPECIAL REFERENCE TO THE CRYSTALLIZATION OF SNOW.

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(*Read before the Canadian Institute, December 15th,* 1860.)

As this *Journal* is not addressed exclusively to the scientific reader, but to the members of the Canadian Institute at large, it is necessary to offer a brief explanation of the more important questions involved in the general study of crystal-forms, before adverting to the special object of the present communication.

The forms assumed by natural bodies are of two general kinds :—(1) *Accidental,* depending not so much on the actual nature of the body, as on surrounding conditions; and (2), *Essential or Regular.* Accidental forms are most rare (if indeed ever truly present) in Organic Nature. Every plant and animal, and each portion of a plant and animal, has its one fixed and determinate form, never really departed from, except in the case of monstrosities. Amongst minerals, on the other hand, accidental forms, or such as are common, under certain circumstances, to all minerals, are of frequent occurrence. The Mineral Kingdom, however, possesses also its definite or essential forms. These, whether transparent or opaque, are termed *crystals.*

So far, therefore, as regards the regular or essential forms of Nature, two form-producing powers appear to exist, *viz.*, vitality and crystallization. Forms which arise from a development of the vital force,

exhibit rounded and confluent outlines; whilst those produced by crystallization, are made up of plane surfaces, meeting, in sharp edges, under definite (and for the same substance, under constant) angles.* Although crystals usually originate when matter passes slowly from the gaseous or liquid condition into the solid state, crystallization and solidification are not actually identical. Various substances, for example, such as silica in certain conditions—its hydrate (constituting the different opals)—gums,—certain resins, &c.,—appear to resist altogether the action of crystallization. Mr. Graham (the present Master of the British Mint) has suggested that these bodies may retain, or retain to a greater extent than crystalline bodies, the latent heat which they possessed before solidification.

The crystal forms and combinations met with in Nature, exclusive of those produced by the chemist in his laboratory, are exceedingly numerous, many thousands being known to exist. By the help of certain laws, however, and, more especially, by the aid of one, termed "the Law of Symmetry," we are enabled to resolve these multitudinous combinations into six groups or systems. The forms of the same group combine together, and may be deduced mathematically from each other; whilst those of distinct groups are unrelated. Thus, although the cube, the rhombic dodecahedron, and the regular octahedron, appear at first sight to be unconnected forms, yet by the Law of Symmetry their co-relations may be readily shown. This law, for instance, exacts one of three things, of which the most important is to this effect, *viz.*, that if an edge or angle of a crystal be modified in any way, all the similar edges or angles in the crystal must be modified in a similar manner. Now the cube has twelve similar edges and eight similar angles. Consequently, if one edge or one angle be truncated, or, to use a term more in conformity with the actual operations of Nature, if one of these be *suppressed* during the formation of the crystal, all the other edges (or angles) must be suppressed equally; and if the new planes which thus arise be extended until they meet, the rhombic dodecahedron on the one hand, and the

* This law is affected within slight limits by isomorphous replacements, and also by changes of temperature. The law itself appears to have been discovered by Nicolaus Steno (then a naturalized Florentine) as early as 1669, but its true importance was not appreciated until the re-announcement, or rather re-discovery of the law in 1772 by the French crystallographer, Romé de l'Isle. Many of the contemporaries of the latter—amongst others, the celebrated Buffon—attempted to deny its existence, but being susceptible of practical proof, its truth was soon established.

regular octahedron on the other, will result.* These forms, moreover, as well as their intermediate oscillations, frequently occur in the same substance: red oxide of copper may be cited as an example. But between the cube, a square prism, and a rhombic prism, no relations of this kind exist. Neither are these forms related physically: for their optical, thermal, and other physical relations are equally distinct. By considerations of this sort, therefore, we are able to establish six (or really seven) distinct Crystal Systems. These (named chiefly in accordance with the relations of their axes) are enumerated in the annexed tabular view.†

Crystal-axes of one length. Refraction, single		*The Monometric System* (including the cube, rhombic dodecahedron, octahedron, &c., with their various combinations.
Crystal-axes of two lengths. Refraction, double, with one neutral line or optical axis		*The Dimetric System* (including square-based prisms and pyramids with their various combinations.)
		The Hexagonal System (including regular hexagonal prisms and pyramids, rhombohedrons, &c., with their combinations.)
Crystal-axes of three lengths. Refraction, double, with two neutral lines or optical axes.	Axes at right-angles.	*The Trimetric System* (including right rectangular prisms and pyramids, rhombic prisms and pyramids, and combinations of these.
	One axis oblique.	*The Monoclinic System* (including oblique rectangular and rhombic combinations.)
	All the axes oblique.	*The Triclinic System* (including doubly-oblique combinations.)

* The Law of Symmetry, in its exact acceptation, may be thus expressed:

(1.) If an edge or angle of a crystal be modified, *all* the *similar* edges or angles must be equally modified.

Or (2.) *One-half* or *one-mth* of the corresponding angles or edges, in alternate positions, must be equally modified. *Example.*—Cube and Tetrahedron (Boracite; Arseniate of Iron.)

Or (3.) *All* the similar edges or angles must be modified by *one-half* or *one-mth* the normal or regular number of planes. *Example.*—Cube and Pentagonal Dodecahedron (Iron Pyrites.)

Conditions 2 and 3 produce *hemihedrons* or *part-forms*.

† See also Vol. V. of this Journal (New Series), pages 7-9.

In each of these Systems, it often happens that two or more crystals are united, forming the so-called twin or compound combinations. When four individuals are thus united, cruciform crystals usually originate; and stellate combinations frequently arise from the union of five or six individuals. Of these latter, the six-rayed stelliform crystals of snow must be familiar to all Canadian readers. These snow crystals have hitherto been referred, by almost universal consent, to the Hexagonal System of Crystallization—to which, indeed, at first sight, they naturally seem to belong. Now the object of my present communication is to shew that this generally received view, whilst unsupported by anything like actual proof, is opposed by much evidence of a more or less direct character. This evidence is based, first, on the occurrence of stelliform groups amongst minerals; and, secondly, on the results afforded by some experiments on the crystallization of dilute solutions of various salts.

Amongst the natural products of the mineral kingdom, stelliform six-rayed groupings and pseudo-hexagonal combinations occur (more especially) in Discrasite or Antimonial Silver, Chrysoberyl, Sulphate of Lead, Carbonate of Lead, Carbonate of Baryta, and Arragonite: all of which belong to the Trimetric System. To these must be added the curious stellate groupings of native copper from Bosgolowsk in the Northern Ural—described by Professor Gustav Rose, in his "Reise nach dem Ural," in 1829—the only example of a Monometric combination of this kind, hitherto made known. Stellate groupings amongst Hexagonal minerals (always omitting the doubtful snow-crystals) have not been recognised; although in the opalescence of certain corundums something akin to this structure may perhaps be admitted. Apart from this exceedingly indirect evidence, the assumed crystallization of snow receives therefore no support, but the very reverse, from what is known respecting mineral bodies of natural formation. Let us inquire if artificially-produced crystals will throw any additional light upon the question.

From time to time, during the last three or four years, I have been making a series of experiments on the crystallization of dilute solutions of various salts. These experiments have been made with the primary object of ascertaining whether the crystallizations, thus produced, do not follow certain definite laws in their arrangement; and although I have failed, up to the present, to establish anything very satisfactory in this respect, I still hope to succeed eventually; and my observations

have shewn me several curious facts: amongst others, one that has led me to the present inquiry. I have found, for example, that compound stellate crystals, resembling exactly many of the star-crystals of snow, may be produced in salts belonging to various systems of crystallization—although I have not succeeded in obtaining them from Hexagonal salts: another fact—so far as it goes—against the assumed crystal system of snow. Omitting all doubtful and in any way unsatisfactory cases, I have obtained repeatedly these stelliform combinations in the five substances enumerated below; and the list, I have no doubt, will be ultimately much extended:

Monometric Substances.

Camphor = 20C, 16H, 2O. Star-crystals obtained from solution in alcohol. These crystals require to be examined as soon as formed, as they evaporate with great rapidity. Sal Ammoniac = Am Cl.

Trimetric Substances.

Sulphate of Magnesia = MgO, SO^3 + 7HO.

Monoclinic Substances.

Glauber Salt = NaO, SO^3 + 10 HO.

Bi-carbonate of Potash = KO, $2CO^2$ + HO.

Observed star-crystals of Camphor, Sulphate of Magnesia, and Glauber Salt are shewn, respectively, in figures 1, 2, and 3.*

Fig. 1.

Fig. 2.

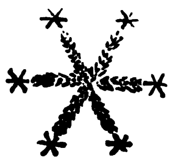

Fig. 3.

The production of six-rayed stellate crystals in Glauber Salt and Bi-carbonate of Potash, is a fact of some interest: since it has been supposed that Monoclinic forms could not occur in groupings of this kind. None it is true are met with amongst minerals of natural formation belonging to the Monoclinic System, but my results shew clearly that they are capable of occurrence.

Summary.—From the observations recorded in this communication, the following conclusions may be deduced:

(1.) Stelliform six-rayed crystals are common to various systems—

* These figures are very badly executed, but they will serve to show the general character of the crystallizations to which they refer.

occurring not only in the Trimetric and in the Monometric Systems, new examples of which (as regards the latter) are described above; but also in the Monoclinic System, in which until now, none have been announced; and in which, moreover, by some observers, these crystals have been thought of impossible occurrence.

(2.) Although thus shown to occur in various systems, none have yet been recognised, with certainty, amongst minerals or in artificial crystals of the Hexagonal System.

(3.) Hence—from the facts given in conclusions 1 and 2—the assumed Hexagonal crystallization of snow, if not disproved, becomes at least of very doubtful acceptation.

NOTICES OF BIRDS OBSERVED NEAR HAMILTON, C. W.

BY THOMAS MC'ILWRAITH ESQ.

To those who are aware of the many additions which have of late years been made to the list of American birds, as well as of the difference of opinion which still prevails among authors regarding the identity of certain species, it must be evident that our knowledge of this branch of our Natural History is by no means complete. Probably, the greatest difficulty in the way of getting anything like conclusive information on the points in dispute, arises from the migratory character of nearly all the birds of North America, and the remote regions in which they spend the interesting period of reproduction; so few indeed, can be called *resident*, that if we take any point on the continent and ascertain the number of species which reside there all the year round, we are astonished at the smallness of the list; in our own case it would not exceed a dozen species, and even of these, it is doubtful whether those we see in summer are not replaced by other individuals of the same species, coming from the north at the approach of winter.

Another perplexing subject to the ornithologist has ever been, the changes of plumage which birds undergo at certain periods of their lives, or at particular seasons of the year. This is most remarkable among our rapacious birds, many of which do not come to maturity in plumage till their 4th or 5th year, and having been found breeding in the immature dress, have frequently been described as distinct species.

The same cause has led to considerable confusion among our short winged summer birds, these arriving among us about the end of the first week in May in their full summer plumage, and uttering their characteristic notes are easily identified, but when they return again from the north in September, accompanied by their young, the change they have undergone is so great that no one unacquainted with the subject would be able to recognize them. As an instance of this I will only mention the male of the Scarlet Tanager, whose brilliant plumage, so conspicuous in the woods during the summer months, as soon as the breeding season is over, becomes like that of the female, a plain dull green; it is not then surprising that the earlier writers should have frequently described the same species twice under a different name, indeed, in the absence of information from those who had opportunities of observing the birds while the changes were progressing, we do not see how it could have been otherwise.

Wilson no doubt felt these difficulties keenly, when commencing his great work on American birds, and seems, in his writings, to long for the opportunity of solving his doubts by personal observation. When describing the Black-throated Blue wood-warbler, which belongs to the migratory class referred to, he takes occasion to reproach the Canadian people for their want of interest in these subjects; he says, "I know little of this bird, it is one of those transient visitors which in the month of April pass through Pennsylvania on their way to the north; it is highly probable that they breed in Canada, but the summer residents among the feathered tribes, on that part of the Continent, are little known or attended to; the habits of the deer, the bear, and the beaver, are much more interesting to these good people, and for a good substantial reason too, because more lucrative, and unless there should arrive from England an order for a cargo of skins of warblers and flycatchers sufficient to make them an object worth speculation, we are likely to know as little of them hereafter as at present." Without doubting the truth of Wilson's remarks at the time they were written, I am satisfied that they no longer hold true, as there are now many people in Canada, devoting both time and means, in acquiring the information he so much desired, and there are, in some of our Canadian Cities, collections which would have been of great service to him when arranging the material for the American ornithology. When estimating the amount of Wilson's labors in this field of science, we should never overlook the peculiar difficulties

he had to contend with; he had not the means, neither were there in his day facilities for making long journeys, at small expense, such as we now enjoy; his researches were therefore chiefly confined to the middle Atlantic States, yet within that limited space of what is usually termed North America, he described over 280 species of birds, many of which had been entirely overlooked by previous writers.

When referring to the few mistakes he made, we must also remember that he had not access to any library of Natural History, such as now exists in many of the American Cities, neither was there at that time any museum worthy of the name, to which he could repair with his doubtful species. To him, however, Nature's great Museum in the woods, was ever open, thither he went, gun in hand, in quest of his favourite birds, and the habits of such as came under his own observation, he has described with a truth and felicity which has never been excelled.

Audubon followed with all the enthusiasm peculiar to his countrymen, and by extending the field of his observations and procuring specimens from distant parts of the continent, brought up the number of described species to about 500.

Since the time that the writings of these authors were submitted to the public, many influences have been in operation to bring the subject nearer to completion, foremost of which have no doubt been, the general diffusion of knowledge, and the attention which has been paid to education throughout the United States. A new field of observation has also been opened up by the annexation of Texas, New Mexico and California, where a great variety of birds are found which do not occur on the northern or eastern part of the Continent; these vast territories have been visited by various scientific men, who have published from time to time their notes and observations on the new species of birds met with, but owing to the great expense attending the getting up of such works with costly illustrations, they have never been much known to the public.

The American Government too, deserves all credit for the facilities it has granted, for collecting, arranging, and publishing, the most recent discoveries on this subject. With each of the exploring parties which have within the last few years traversed the western part of the Continent, for various purposes, officers have been sent, specially charged with making notes and collecting specimens of the natural history of the different regions through which they passed, and the

most complete synopsis of North American birds which has yet appeared, is the 9th volume of a report of explorations for a route for a railroad from the Mississippi to the Pacific. The work is got up at the expense of the Government, and the volume referred to, which treats exclusively of Birds, has been prepared under the able superintendence of Dr. S. F. Baird, of the Smithsonian Institution. The new western species are therein minutely described, and for the sake of comparison, those already known on the eastern side of the continent, have also been introduced, which makes the work a complete exposition of all that is at present known of the birds of America north of Mexico. The total number of species described in this work is 716, and it is highly probable that many additions will yet be made of scarce species, which have escaped the notice of travellers. From the Hudson Bay territories we have yet much information to obtain, regarding many species which are familiar to us at certain seasons of the year, but spend the most interesting period of their lives in these remote regions. During the last year Mr. R. Kennicot, a Naturalist of considerable experience, has been sent out under the auspices of the Smithsonian Institution, for the special purpose of supplying the information wanted from this quarter, the result of his researches with the amount of new material already on hand, will be ample for a comprehensive work on this subject, which will, no doubt, appear in due time.

As regards the birds which frequent the vicinity of Hamilton, I would remark, that the changes consequent on the settlement of the country, have produced corresponding changes in the Fauna of this district, many species being now wanting, which were common 30 years ago, and others, which at that time were unknown, having now become quite plentiful.

The older settlers tell us that when Hamilton was but a village, and the farm houses but thinly set along the lake shore, the flocks of waterfowl, which frequented Burlington Bay, were so great as frequently to darken the light of the sun by day, and make the night hideous with their discordant cries. In those days, they say, when money was scarce, the speculative farmer. who wished to add a few waterfowl to the stock of produce he was making up for the Saturday's market, counted the cost of the ammunition before throwing it away; if sure of securing half a dozen ducks at a single discharge, the gun went off, but if only a less number could be got within range, it was taken

back as it was, and set aside till a more favorable opportunity occurred. While this state of matters prevailed, the birds must have been little disturbed, and would, as a natural consequence, congregate in greater numbers, and making due allowance for the habit of veteran sportsmen exaggerating what happened in their young days, there can be no reasonable doubt, that Burlington Bay has long been a favorite resting place for the vast flocks of Ducks, Geese, and Swans, which periodically pass to and from their great nursery at the north, but which of late years occur at more uncertain periods, and in greatly reduced numbers. A moment's reflection will point to the causes which have produced the changes referred to, foremost of which is, no doubt the great amount of traffic which is now carried on with steam and sailing vessels during the summer season, besides which, we have on the one side of the Bay an establishment for making gunpowder, and on the other a city with a population of 25,000 inhabitants, among whom are a fair proportion of amateur sportsmen; these, though they may not much reduce the number of the birds, yet disturb them at their feeding grounds, and have driven them to seek for greater seclusion, among the extensive flats near Chatham, and along the river St. Clair.

Among the land birds, similar causes have been at work to produce changes in the habitats of different species. We are told that before the heavy timber was cut down, and the girdled trees were yet standing thickly in the cornfields, woodpeckers, of different sorts, were much more numerous than at present, the large *black log cock* being often seen, and the strokes of his chisel frequently heard reverberating through the woods. I am not aware of this species being seen in our neighbourhood for some time, the last specimen having been brought to the market by a farmer about five years ago as a great rarity; they are now found in Canada to the north and west of us, and throughout the state of Michigan.

As the dense forest became broken up, and the cultivated fields appeared, a new class of birds took the place of those which had left; no sooner had the early settler raised his log house and planted his fruit trees, than he was visited by the Cat bird, whose great delight seems to be to nestle near a log-house on the edge of a clearing; the merry jingling song of the Bob-o-link was also heard along the fences, and the Blue birds, who delight in the society of man, found a nesting place in the new settlement; several species of warblers also

are now found farther north than the limits assigned to them by their historians, and as the country is better cleared, we may yet expect to find many species in our woods and gardens which at present do not come so far north.

Of the birds found in our vicinity *at present*, I may say that these first attracted my attention in the spring of 1856 while indulging in a series of morning rambles along the edge of the mountain, west of the city. Since that time I have devoted some of my leisure hours to preserving specimens, and have been able to identify all the sorts procured, though it may be worthy of remark, that at the time referred to, there was not even the beginning of a museum in the city, and the principal public library contained no book which could be of the least assistance to the amateur, in this branch of Natural History.

It will not be expected in a paper of this description that I can refer to each of the numerous species which frequent our woods and marshes: for the benefit of those who may be desirous of obtaining fuller information of this description I have prepared a list, which has already appeared in this Journal, of all that have come under my own observation, arranged according to the classification of Audubon in Families, Genera, and Species. I will now only refer to a few of the more remarkable species in the different Families.

Following the arrangement referred to, we find highest on the list, the Family *Falconidæ*, which includes all our Diurnal birds of prey, such as Eagles, Hawks, Buzzards, &c. These are distinguished by their short and powerful beaks, strong hooked talons, and the great length and breadth of their wings; this class is well represented in our woods, and along the Bay shore; the most conspicuous member of it being the *Bald Eagle*, whose grand circling flight makes him an object of interest wherever he appears. With us this species is seldom seen during summer, but at the approach of winter, when the fish hawk has gone south, and game gets scarce in the woods, a few pairs are usually observed about Land's bush, and along the beach, where they prey on musk rats, and feed on such animal matter as may be thrown up by the waters of the Lake. During the two past winters the fishermen residing on the beach have been offered a liberal price for a mature specimen of this bird, but so difficult are they of approach, that although individuals have been seen nearly every day during two months in each season, yet all the

exertions of the hunters have been quite unsuccessful. Occasionally after the report of some heavily laden piece, a single broken feather has been seen winnowing its way downward, but as yet no mature specimen of the eagle has been procured. Latterly, the hunters being foiled in the chase, have resorted to stratagem, and have tried to poison the birds by putting strychnine into the body of a small animal, and leaving it near their usual hauuts. By this means two or three individuals were obtained, but all of them have been young birds, which are of a brownish colour, more or less blotched with white. The only instance I have heard of the capture of the mature Bald Eagle. in this vicinity, occurred some years ago, but may be worth repeating as tending to illustrate the habits of the bird. A labouring man residing in the outskirts of the city, found that some depredator was levying black mail upon his chickens, and resolved to put a stop to it; at midnight he visited the roosts with his musket but all was quiet and no trace of mink or fox visible; about day break, however, there was a disturbance among the fowls, when, jumping up he was just in time to take a hurried aim at a large eagle, who was gliding off with a plump chicken clutched firmly in his talons. The shot took effect in the outer joint of the wing, which brought the spoil-encumbered marauder to the ground, pursuit and struggle then ensued, the eagle according to custom throwing himself on his back and fighting fiercely with his feet. In this curious engagement the gunner for a time had the worst of it, as owing to the hurried way in which he had been called into the field, he was ill prepared to contend with the sharp claws of his powerful adversary. On further assistance arriving from the house the eagle was secured alive, and brought into the city by his captor, who happened to be at work at the Goal and Court house, then in course of erection; here he was put for convenience into one of the cells, where he was visited by many of our citizens, some of whom gave expression to their wit, over the circumstance of the first prisoner confined in the Jail, being the rapacious symbol of American freedom.*

The young of this species differs from the adult so much in appearance that till within the last few years they were considered as distinct species, the former being described as the "*grey sea Eagle*," Wilson, who closely observed their habits, had suspicions that they were identical, but the fact was not proved till after his time.

* While the above was in type the writer procured a fine specimen of the adult animal, measuring three feet by six feet six inches.—January, 1861.

The same mistake was made with the *Golden Eagle* of Britain, the young of which was described as the *Ring-tailed Eagle*, till they have now been proved beyond doubt, to be the same. This species is also American, several specimens having during the past winter been found near Toronto. Besides the foregoing, there are various other species of Eagle said to be found on this part of the continent, one of which was discovered by Audubon and named by him after Washington, but from the real scarcity of the species, and the difference which exists among birds of different ages, we cannot at present speak of them with any degree of certainty.

The most interesting genus of the Falconidæ is that which includes the true falcons; these are distinguished from the other members of the family, by their comparatively short and hooked beak, long and pointed wings, by a tooth-like process near the tip of the upper mandible, and by the dash and courage they exhibit when striking their prey on the wing; there is probably no other bird so admired by the sportsman, or feared by the waterfowl, as the *Peregrine Falcon*. We have often heard those who periodically visit Long Point, or Baptiste Creek, to practise Duck shooting, speak with enthusiasm of the exploits of the Bullet Hawk, as he is termed by the gunners; he is described as flying at considerable height above the marshes, which are dotted with flocks of geese, ducks, teal, and widgeon, his quick eye marking every movement that is made below. While these keep the water, they are comparatively safe, as they can elude their pursuer by diving, but if, in the excitement caused by the presence of so dreaded an enemy, they should attempt to escape by flight, then is the time to witness the stoop of the falcon, who singling from the affrighted flying flock, the victim he has destined for his prey, descends with a rush, which the eye can scarcely follow, and strikes it to the earth in an instant. So suddenly does the bird fall on being struck, that it was long supposed the blow was given by the breast-bone of the hawk. This opinion has by close observation been proved incorrect, and specimens so prostrated, when picked up are found to be so lacerated on the back as to leave no doubt that the stroke is given by the feet. This noble bird is well known to the residents on Burlington Beach, where he has frequently been observed coursing along in quest of his favorite prey, but from the uncertain nature of his visits, and the rapidity of his flight, no specimen has yet been procured. A recent writer professes to have found specific

distinctions between this, and the British bird of the same name, but these do not seem to be clearly made out, and the general opinion is, that it is identical with the the Peregrine Falcon, so much in favor when hawking was a princely amusement in Europe; with us he follows the full bent of his own wild nature, and unencumbered by hood or bell, roams the whole Atlantic coast, from Greenland to Cuba, and inland to the Rocky Mountains, and is known in the different districts he visits by the various names of Peregrine Falcon, Bullet Hawk, Duck Hawk, and Wandering Falcon.

Following Falcons in order come the *Owls*. Birds of this family are easily distinguished by the largeness of the head and eyes, and the forward direction of the vision; of this class I have noticed eight different species near the city, none of which are plentiful, yet from their strictly nocturnal habits, they may be more so than we are aware of. They are all migratory, and from sometimes meeting with two or three individuals in a single excursion, and again not seeing any during that season, we infer that they pass along in bands, keeping up the communication by their loud hooting, which is frequently heard at night during spring and fall. *The Snowy Owl*, styled by Wilson the "great northern hunter," is during some winters quite common around the shores of the bay, though in others only a very few are seen; during the winter of 1858—'59, I am aware of seventeen specimens having been brought to the market by fishermen and others, while during the last winter, only two individuals have been killed. All the birds of this class have the plumage remarkably full and soft, which enables them to skim noiselessly on their prey, and clutch it ere it is aware of the danger.*

Passing the *Goatsuckers*, of which we have two species, the Whip-poor-will and the Night Hawk, we come to the *Swallows*, of which we have five; in this group we have an instance of the way in which birds sometimes adapt their habits to suit particular circumstances. The republican or cliff swallow, which is but a recent addition to the fauna of this part of the continent, in its original character, builds its nest in caves, and under the overhanging ledges of perpendicular rocks; when lured to this district probably by the abundance of their favorite insect food, which is found along our marshy lands,

* It is worth noting, as an instance of adaption to circumstances, that the eyes of the Snowy Owl and the Hawk Owl, which migrate to the Arctic Regions, are so constructed, as to enable them to procure their prey by day as well as by night—an evident necessity where there is no night for six weeks.

and not finding rocks suitablefor their purpose in the breeding season, they frequently choose, as a substitute, the end of a barn or other outhouse. I have seen such a republic in the country, where the upper part of the end of a barn was literally covered with clay, and perforated with numerous circular holes, out of which the full dark eyes and gaping bills of the callow inmates were frequently seen protruding; there must have been from two to three tons of clay used in the work, and the constant visits of the parent birds at this interesting season give the building at a short distance much the appearance of a great bee-hive.

In the habits of the *Swift or Chimney Swallow* is another deviation from the established custom. When we see these birds circling round in the air and dropping perpendicularly into our chimneys to roost and rear their young, the question very naturally arises, where did they build before the invention of chimneys? Naturalists tell us that their nesting place then was in hollow trees, broken off midway and open at the top, but that now, even where these can be had, the chimney is preferred. We can easily understand that in settled parts of the country, when their favourite trees are all cleared away, they must either leave the district, or change their abode, but why they should, in places where they have their choice, leave the open tree for the open chimney, is still, I believe, an unanswered question.

Next in order come the *Flycatchers*, birds of small size, but in their habits much resembling the birds of prey. These have the upper mandible overhanging and notched at the tip, and the voice, in most cases, harsh and discordant. The mode of taking their prey varies in different species, some, taking up a station on a post, or limb of a tree dart after the passing insect making the snapping of the bill distinctly heard, others more expert of wing, keep skipping about among the bushes, and take by surprise any thing suitable which comes in the way. A prominent member of this group, is the *King bird*, or tyrant flycatcher, well known on account of his depredations among hive bees; he is also remarkable for the courage he displays when guarding his nest and young, being known to drive even the Bald Eagle from his vicinity.

Nearly allied to the flycatchers, but differing from them in form and habits, are the *Wood-warblers*. There is no class of small birds so much sought after by collectors as these, they are a numerous family, generally graceful in form, sprightly in manner, and brilliant

in colour; they arrive here about the beginning of May, a month, which, above all others, is enjoyed by those who are fond of rambling in the woods. Their food seems to consist chiefly of insects, which they find lurking among the opening buds and blossoms of the trees. A few species remain with us during summer and rear their young, but the great body pass on farther north to breed, returning again in September, though from the trees being more full in leaf at that season, and the birds silent, they are not so much observed. I have noticed 22 species belonging to this family, in our woods, some of them of rather rare occurrence, among which I may mention the *Sylvia Maritima* or *Cape May Wood-warbler*. Wilson met with this species only once and Audubon mentions it as being exceedingly rare. I found it in the spring of 1857 along with others of the same family, while on their annual journey northward.

The Family of *Creepers* includes besides the tree creeper, (the type of the class) the Genus *Wren*, of which we have three species, viz. the *Marsh wren*, which builds in all the marshes round the Bay, the *Winter wren*, which is identical with the common wren of Britain, and the *House wren*, which seems to have discovered Hamilton only within the last two or three years. This little bird is strongly attached to the dwellings of man, and in the United States is frequently accommodated with a house fixed to a post or tree in the orchard, which is taken possession of as soon as the birds arrive from their winter quarters. During the past two summers several pairs of house wrens have raised their brood in our city gardens, though previous to that date, I have not heard of their being observed.

Of *Thrushes* we have five species, among which is an instance of the difference of habit which is frequently noticed even among birds which in many respects are closely allied to each other. The red breasted thrush or *Robin* is well known for his familiarity, frequently rearing his young close to our dwellings, yet his near relation the *Wood-thrush* is one of our most retiring songsters, and is seen only in the most secluded parts of the woods; perched on the highest twig of a tall tree his full sweet notes are frequently heard, but the moment he is aware of being observed he drops under the tree tops and glides off in silence.

This group includes our best songsters, some of whom make the very woods ring with their thrilling notes. I have frequently heard the remark that our Canadian birds, though gaudy in plumage, are

quite deficient in song, my opinion of this matter is, that comparing the birds of North Britain with those of Canada, we have only to strike from the former list, the British Sky-lark, to be able to compete successfully, either as regards the number of performers, or the variety and sweetness of their notes. I have often imagined (but it may be only a fancy) that there is a strange harmony existing between the voices of birds and their particular places of resort; I have noticed this in winter in the short sharp note of the Nuthatch, who as he hurries about seems ever to say that he must bestir himself as the days are short. The lively twittering of the warbler seems to blend with the first fluttering of the young leaves; the shrill piping of the plover is quite in unison with the whistling of the sea breeze, which comes up over the treeless barren which they usually frequent, and surely if we had sought through the whole feathered race, for a tenant to our gloomy cedar swamps, we could not have found one more suitable than the great horned Owl, whose solemn aspect, and singular voice, makes the solitude of such places still more intense.

The Family of *Finches* is one of our most comprehensive groups, it has been divided by Audubon into 18 different genera, and contains according to that author 55 species. Of these a fair proportion are found in our fields and gardens, where they render considerable service by ridding the ground of the seeds of such troublesome plants as the dandelion and the thistle. The greater number are summer residents only; a few remain all the year round, and one or two species visit us from the north only in severe winters; of the latter class a rare species has during the past winter been observed in considerable numbers round the city. I refer to the pine grossbeak, which was first observed about the 5th or 6th of January, in a garden in Merrick Street, feeding on the berries of the Mountain Ash. They attracted attention by the unsuspicious way in which they followed their occupation, almost within reach of the people who were passing on the side-walk, shewing clearly that they were little accustomed to the society of man. In small flocks, they continued to frequent the gardens where their favorite berries were to be obtained, till about the 23rd of February, when a strong west wind, accompanied by warm rain prevailed for a day and a night, after which they were no more seen. In the winters of 1856–1857 they paid a similar visit, but have not been observed in any other year. Nearly all those which visited this part of the country were either young males or

females. The adult male was much sought after on account of his showy crimson plumage, but only a few of them were procured. It is worthy of remark, that the Grossbeaks are frequently, if not always, accompanied by true Bohemian Chatterers; which latter feed on the stem and pulp of the berries of the Mountain Ash, rejected and thrown down by their hard-billed fellow travellers.

(To be continued.)

NOTE ON THE OXALATE OF IRON.

BY H. CROFT, D. C. L.

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In a recent number (Nov. 3rd,) of the *Chemical News*, among the extracts from foreign journals, (Comptes Rendus, 51–17,) there appeared a short note on the so-called Quadroxalate of Iron, by Dr. Phipson, the formula being given as $Fe\,O, 4\,C^2O^3$. The correct name representing its composition being given, it does not appear that there can be any typographical error in the formula, which would otherwise seem likely, from the excessive improbability of the existence of an anhydrous quadroxalate of a heavy metallic oxide. The absurdity of the formula becomes still more apparent if the method of preparation be considered, viz.: by precipitating ferrous sulphate by oxalic acid, or better by oxalate of ammonia. In this latter case these two neutral salts must so decompose each other as to produce a highly acid insoluble compound, and set free three equivalents of ammonia, by which the supernatant liquid must become strongly alkaline; a species of decomposition the writer believes to be as yet unknown in chemistry. $Fe\,O, S\,O^3 + 4, N\,H^4O, C^2O^3 = Fe\,O, 4\,C^2O^3 + N\,H^4O, S\,O^3 + 3\,N\,H^3 + 3\,H\,O$. It is scarcely necessary to say that nothing of the kind takes place. The salt is described as being yellow and giving with ferricyanide of potassium a green substance, owing to partial decomposition, a fact which is not altogether incomprehensible, when it is remembered that $Cfdy\,K^3$ gives a blue colour with salts of $Fe\,O$, and that blue and yellow produce green.

It is a pity that Dr. Phipson, when writing on any subject, should not have previously made himself acquainted with facts which have been known for nearly five and twenty years,—the salt being nothing

more than the ordinary oxalate of iron containing two equivalents of water, $Fe\,O, C^2O^3+2$ aq. This compound has been described by Vogel and Berzelius, its composition shown by Döbereiner and Rammelsberg, who appear to have proved that it differs from the rare mineral Humboldtite in containing half an equivalent more water, $Fe\,O, C^2O^3+1\frac{1}{2}$ aq and $Fe\,O, C^2O^3+2$ aq, or $\left.\begin{matrix}C^4O^4\\Fe^2\end{matrix}\right\}O^4+3$ aq and $\left.\begin{matrix}C^4O^4\\Fe^2\end{matrix}\right\}O^4+4$ aq, corresponding to the manganous oxalate. More recently it has been examined by Souchay and Lenssen, in their extended investigation of the oxalates.

In order to test the matter still further, the salt was prepared by my pupils, Mr. Ramsay and Mr. Thomson, in both ways indicated by Dr. Phipson, using a large excess of oxalic acid in the one case, and precipitating both from concentrated and from very dilute solutions, in both cases the precipitation takes place almost immediately.

The subjoined quantities of Fe O were obtained. It will be observed that the amount of Fe O is a little below the requisite quantity, both in these analyses and in those of Rammelsberg which are appended, owing to the salt retaining a certain amount of hygroscopic water, unless dried for a long time at 100°, and also to the fact that when heated it is not perfectly oxidized unless the heat be continued for a long time or the residue be moistened with nitric acid and again heated, as was done in No. I; No. IV was only air dried.

			Cal'd.	I	II	III	IV
Fe O	1	36	40	39·70	38·91	38·68	38·08
C^2O^3	1	36	40				
H O	2	18	20				
		90	100				

Fe O — Rammelsberg — 38·78 — 39·10 — 38·92 — 38·84 — 39·48

University College Laboratory, Dec., 1860.

The 17th number of the *Comptes Rendus* having come to hand, the writer is enabled to give the analyses on which the above formula is founded, viz: Fe O—19·35—19·44

C^2O^3—80·65—80·56

100·00 100·00

From the exact accordance of the analyses it is evident that the oxalic acid was not determined, but only calculated from the loss, and as the

quantity of Fe O is exactly one-half of that obtained by other chemists, it seems probable that Dr. Phipson has made the ludicrous mistake of calculating the protoxide corresponding to the obtained peroxide as Fe O and not as Fe^2O^3, and considered all the remainder as oxalic acid.

ON THE TRUE AIMS, FOUNDATIONS AND CLAIMS TO ATTENTION OF THE SCIENCE OF POLITICAL ECONOMY.

BY THE REV. W. HINCKS, F. L. S.

Read before the Canadian Institute, March 10th, 1860.

The question may not unreasonably be asked how, after the numerous and excellent works published on Political Economy, it can be needful to enter here on discussions relating to its elementary principles or the grounds upon which it is entitled to attention. My reply is that, whatever may have been accomplished, which to many may appear important and satisfactory, Political Economy is still too new a science for its influence to have penetrated the mass of society, and has from various causes been exposed to so many attacks and so much misapprehension, that it may well be thought to demand the support of those who feel its value, and can hardly pretend to be removed from that field of controversy which may be expected occasionally to supply us with subjects, and is fairly open to all those who will venture themselves upon it. If I could suppose that we are all nearly agreed as to what are the well established truths of economical science, and as to the kind of authority which belongs to them, I should not have engaged in a superfluous labour; but having no doubt of the extended diffusion of opinions altogether opposed to those which seem to me to result from scientific inquiry, I would test the stability of the structure on which I am disposed to rely, by having its materials and foundations fairly examined. On this as upon all subjects, I seek real knowledge and hope to profit from cautious and candid inquiry. But it seems to me that there could be no useful discussion of specific questions in economical science without a previous consideration of the way in which its inquiries are

carried on, and the ground upon which its principles may claim public attention. Let us in the first place guard against the mistake of attributing to the science a wider range and a greater power over human affairs than it can legitimately pretend to. The subject of political economy is *wealth*, under which name we include all objects of human desire which are capable of being appropriated. The object proposed by the science is to investigate the laws which regulate the production and distribution of wealth. It is hence obvious that political economy is one branch only of social science, which treats of whatever affects the condition of man as a social being, in order to determine the best means of promoting generally diffused happiness, In this are included government, jurisprudence, education, the treatment of criminals, sanitory regulations, the social position and rights of woman, and other topics of which the interest and importance are very great, but which, though connected together as branches of one great subject, and inviting attention in common, are yet sufficiently distinct in the kind of facts with which they are concerned, to admit conveniently of separate treatment. It is of course manifest in the first place, that if there are no absolute laws or necessary tendencies in respect to the acquisition and distribution of wealth, there can be no science of political economy. A natural law is a general expression of facts already observed, put forth as a guide for the future, in order that by adapting our conduct to it we may make every available use of forces in operation, and may avoid the injuries arising from vain attempts at resisting them. The operation of a natural law is sometimes modified or obscured by the simultaneous action of some other force besides that which we are considering, but it is not the less real or less useful to be known. The floating or rising feather seems to set at defiance the law of gravitation only because it is supported by the atmosphere or wafted by its agitations, and the philosopher feels the force of the general law as much whilst observing its apparent violation, as in contemplating its most striking illustrations. Where results depend much upon the actions of human beings, we know too well the variety of the motives influencing them, to expect perfect uniformity, but if we become acquainted with invariable tendencies belonging to certain circumstances, we already possess valuable guiding principles, and inasmuch as our conclusions are only partially involved with human motives and dispositions, depending much also on laws of the external world, they have really less uncer-

tainty than might be supposed. Political economy is concerned with the conduct of men in reference to certain conditions of their being. It belongs to the superiority of man over the brutes, and to the powers with which he is endowed, that he does not consider merely the enjoyment of the moment, but looks forward endeavouring to provide means of future gratification, and is disposed even to submit to present restraint that he may be free from apprehension respecting the future. It follows from this that he is disposed to guard what he possesses or has the feeling of property, and that he is ready to barter a portion of what he has collected for other objects of desire not immediately within his own reach. The considerations that labour or effort of some kind is the means of obtaining whatever we desire, that what we obtain we regard as belonging to us, or as property, and that we are disposed to barter, to which may be added that what we have already secured makes our further exertions more effectual, lie at the foundation of all inquiries in political economy. We have to do with man as a being seeking means of happiness, and by the faculties he possesses led in its pursuit to labour, to appropriation, to accumulation and to barter. By reasoning on what belongs to our condition, and by experience, we learn the circumstances most favourable to the acquisition of wealth, the proportions in which it is naturally distributed among parties uniting in different ways for its production,—the natural laws regulating exchanges, and the effects of attempts at interfering with the natural course of things by governments. The rules at first laid down from notions of what would be desirable results, with imperfect observation, would be often erroneous, always rude, but time would clear away one error after another, truths would by degrees come to be viewed in their connections, and gradually a body of related principles would be elicited, forming a science, and fitted to afford useful practical guidance as well as enlightened general views of what is passing amongst our fellow men. Those who deny the conclusions of political economists, must either object to some specific principle as being a false deduction, in which case they have to show by fact and reasoning that it is not properly established, and is no part of the genuine science, or else they must maintain that there are no materials for constructing a science; that there is no uniformity of results in classes of cases; that there are no fundamental principles of human nature bearing upon the acquisition and distribution of wealth, and that no general results of experience

can be obtained or applied. If a man takes the first course he may possibly be right, since there can be no pretensions to infallibility, and arguments that have any appearance in their favour should be weighed and their character fully tested, but if he is led to oppose the united opinions of the very able men who have been the founders and chief teachers of political economy in the important cases in which they are almost agreed, the presumption is greatly against him. If he takes the second course, I submit that he plainly manifests ignorance of human nature and social history to such a degree, as scarcely to be worthy of any attention. All history derives its interest and value from its exhibiting the common tendencies and dispositions of human nature, acting under varying circumstances and modified by the genius and education of the individual. The rejection of prevailing tendencies and generally operative motives would make the whole a mass of confusion, from which we could learn nothing, and which would cease to interest us,—and even the fiercest opponents of the conclusions of political economy have their own opposing theories, which they believe to be drawn from experience. The question is not, therefore, as to the existence of useful principles, but as to how they are to be sought, and where they are found. Now, what the political economist asks is, not that his special views shall be received as constituting a science, but that all the facts bearing on every doubtful question may be collected, compared and harmonised, so as to yield a consistent result—he proposes extended observation—possibly in some cases, experiment,—as the means of arriving at truth, and employing these under the guidance of reason, and with regard to well-ascertained common principles of human nature, he cannot despair of ultimate success, though misapprehensions or interested perversions of facts may cause obscurity for a time. There is another point of view from which it may be useful to regard the subject before we conclude. We often hear certain objections made to the science in general, or to some of its supposed results, which those who bring them forward seem to consider as sufficient to excuse their bestowing any further attention on the subject, and I would not pass these by without some notice. A favourite objection is that the political economist is a theorist, and that practical men are the proper judges on the questions upon which he undertakes to decide. I might answer that some of the most eminent political economists have been men extensively engaged in mercantile and monetary

transactions, and who have specially manifested practical knowledge and skill; that others of them with great intelligence and sagacity, whilst free from the personal interests that may be conceived sometimes to warp the judgment, have had most eminent opportunities from intercourse with practical men in different countries and in different pursuits, of collecting the opinions best worth consideration, so as really to know much more of business transactions, and what affects them, than any ordinary merchant, manufacturer or dealer, however careful an observer within his own sphere, can pretend to; but it may be better to ask what is meant by theory, and what are its relations to every branch of human knowledge? Detached facts are of little use, and if conjectural relations among them are supposed, these constitute only an hypothesis, which may be useful in guiding further research, but can seldom be relied upon with any confidence. As knowledge increases we obtain, as the result of observation and reasoning, general expressions, forming principles or laws which show us in relation to the subject in hand what may be expected in certain circumstances—what consequents must attend given antecedents. These collected and arranged constitute the theory of the subject, and it is difficult to conceive how it can be otherwise than the proper and only safe guide to practice. It is quite true that the actual business of life often requires a union of considerations drawn from several different kinds of knowledge, and if a man studies one of them in his closet and applies its theories without regard for other branches equally necessary, he may make gross blunders, and you might possibly express their source by calling him a mere theorist; but is this any reproach to sound theory, or any proof that it is useless, or that we could do without it? A practical man is understood to mean one who has been placed, by circumstances, in a certain employment, and has acquired a certain facility in performing what it demands. From mere constant attention to an operation, with the desire to save himself trouble or increase his gains he may effect improvements, but not unfrequently attachment to the method he first learned, and the force of habit prevent his appreciating real improvements, and his attention is very apt to be confined to the routine of his own business, and to means of promoting his own immediate advantage, without extended inquiry, enlarged views, or fair consideration of the effect of what he desires on others. The practical man, as such, is not then precisely the

authority we should resort to in seeking to make arrangements for the general good. He may add to his practical experience much acquired knowledge, much study and much talent, but he then unavoidably becomes a theorist. He has endeavoured to bring together all the important facts relating to the subject, to see them in their real relations and to understand what they teach. He has become a man of science—a theorist—and as such deserves respect for his opinions, which his habit of attending to details of business would by no means command. The theory of any subject is the precise and orderly expression of all the truths in relation to it, by due regard to which, we should act wisely and accomplish our purposes, so far as is possible and consistent with moral considerations. The cry against theory is a very common one, but it means a cry against knowledge and improvement. Another grand objection to political economy is founded on the alleged cold-heartedness and inhumanity of the conclusions to which it leads. I believe it may be the fact that political economists have shown, or supposed that they had shown, the inutility and even very injurious consequences of certain modes and kinds of charity which are popular and much esteemed. A question is thus raised whether such acts are really charitable. The impulse of a kind heart and sympathetic feelings is not always to be implicitly trusted. If we would do good, we must consider and use our reason. To do what will cause extended evil, in order to gratify our own momentary feeling, cannot be justifiable. If the reasonings of the economist are wrong, and not supported by facts, the alleged bad consequences are not chargeable on the science, but on the mistakes of individuals. If they are correct and well sustained, our object being the real and permanent good of our fellow creatures, we should be thankful for sound instruction, and correct our practice in accordance with juster views. Science enlightens and tends to good: ignorance and error are the sources of evil. If any conclusions fall under our notice which startle us, let us examine their evidence and see whether they are deserving of our confidence. Should they be found so we can but rejoice at having obtained better guidance for our conduct. To object to science because we do not like what it teaches, is to make feelings formed in connection with previous opinions the test of the soundness of new conclusions.

An objection to the science of political economy which undertakes to establish truths of general application, respecting commerce and

the various branches of industry, is often founded on the assumption that different nations have essentially different interests, so that what would be beneficial to one might be injurious to another, and therefore that there really can be no general principles, but trial, experience, and the prudence of those interested must decide what is good in each particular instance. It may be replied that, even granting the interests of some nations to be naturally opposed, they must be so in consequence of certain circumstances of climate, productions, national character or mode of government, which may be understood and explained so as to bring the nations of the world into classes, the laws of economical science being definitely modified to meet the case of each class, and all sound opinions as to what is required for the general good, being still founded on a wide induction of facts, with proper care in tracing particular results to their real causes; but, I believe, the more we examine the more completely we shall be convinced that economical science is based upon what is common to mankind in all circumstances, and gives us rules of general application,—that the more we study it the more thoroughly we believe that, as producers and exchangers of produce, there is one plan which suits us all,—that in peaceful intercourse we may help, but cannot injure each other, and that the intercourse which we are disposed to hold is the appointed means for diffusing the enjoyment of the productions of all climates, and distributing the blessings which flow from arts and industry, as well as those which luxuriant nature freely pours forth. Political economy has substituted for the narrow policy and mutual jealousies of former times, the principle that an industrious nation needs wealthy customers, and that the more other countries flourish the more certain it is that we can be useful to them and they to us, so that mutual interests should make each nation rejoice in others' prosperity, and bind together the world in peace and harmony. This grand lesson of true science is becoming each day better and more widely understood, and will unite, we may hope, with more diffused sentiments of true religion, in checking the ravages of war, and disposing all the nations of men to kindly feeling and the interchange of benefits. Certainly the notions of necessary opposition of interests and natural enmities are as unphilosophical as they are unchristian, and an objection founded upon them will have no weight with liberal minds.

I will, in conclusion, point out in a few words the reasons why this

science deserves general attention, and the claims it has on the especial study of large classes of society. Since the conditions favourable to the accumulation of wealth, the relations of capital and labour, the nature and principles of commerce, the effects of different modes of taxation which may be employed in raising the contributions required for the public service, the effects of attempts to direct industry into particular channels, or in any way to interfere with its freedom—the relation of different kinds of industry to the general good—the causes of poverty and the justice and utility of public action for its relief, are among the subjects of investigation belonging to this science, upon which it endeavours to throw the light of knowledge and reason so as to elicit principles that may guide our course, it would be difficult to say who those are, who are *not* concerned in such inquiries. Undoubtedly the statesman to whom his fellow-citizens have committed the immediate control of public affairs: the merchant and manufacturer who risk their capital in the production or conveyance of what they believe to be in demand: the tradesman who would take an enlightened and well regulated interest in the prosperity of his class: the clergyman who represents, and to some extent directs the charitable feeling of those to whom he ministers, and would desire to express and guide it wisely: the lawyer who looks at his profession in a philosophic spirit, and studies the effects of those social regulations with which he is obliged to be peculiarly acquainted, are all of them bound to endeavour to know what can be known of political economy, and are urged by powerful motives not to neglect its study. It may be supposed that their employments and the direction given to their thoughts, will necessarily make, at least the more intelligent and sagacious among them, good judges on the questions which may arise in their several spheres. The fact is on the contrary that their position exposes each class to peculiar prejudices and delusions, in order to dissipate which, a course of study is required which shall commence with first principles, consider the facts accumulated in their proper order and connection, unfold results argumentatively or historically, in cases where our selfishness cannot interfere, and deduce a series of well connected principles which may be taken as rules for action, to be authoritatively applied where immediate inclination or the feeling of the moment would lead us a different way.

It may possibly be the case that thus far very few from among the

various classes referred to, have really engaged in these inquiries with any use of rational means and of the aids which are attainable. It may even be true that they often think they understand, and adopt very strong opinions when they have not endeavoured to collect various facts, and to systematise their knowledge, much less to estimate properly the views of the great men who have devoted their time and all their powers to the subject. If this be so, we have the less difficulty in understanding the prevalence of many social evils and the formidable checks to social progress; but having contended that there is a science awaiting our study, and that equally personal interest, patriotism and benevolence, urge us to apply to it, whilst the grounds upon which some profess to despise it, are utterly untenable, I have fulfilled my present purpose, and I fear more than sufficiently trespassed upon your patience and indulgence.

DESCRIPTIVE LIST OE THE PRINCPAL CANADIAN TIMBER TREES.

BY CHARLES ROBB, C. E.
HAMILTON, C. W.

In the present crisis in the history of Canada, the economic value of her various natural productions justly occupies a large share of public attention. As a slight contribution towards the general stock of useful knowledge on this head, the subjoined list of our principal timber trees has been drawn up.

It has been the aim of the compiler to exhibit in a concise and convenient form all the most interesting and valuable facts relative to the growth and distribution of the various trees—the purposes to which their respective products in the shape of timber or otherwise are or may be applied in the arts—and the nature and qualities of the timbers generally. It may be hoped that such an exposition of the value of our magnificent forests may conduce, in some measure, to a higher appreciation of their products—either as articles of export, by shewing the uses to which they may be applied in foreign countries—or as materials for our native industry, by pointing out

the various applications of similar materials to the arts in other countries.*

Canada is said to produce about seventy kinds of timber trees, of which at present we make profitable use of not more than eight or ten, the rest being left to absolute decay. Her forests extend over about 360,000 square miles, and are unrivalled throughout the world for the variety of species, and more particularly for the size of the timber of full growth. Of sixty-four samples sent to the Paris Exhibition of 1855, by Mr. Andrew Dickson, of Kingston, one half were collected from an area of one hundred acres. The trees which we find most generally in our woods are, the oak, beech, maple, iron-wood, elm, birch, ash, pine, hemlock, tamarack, cedar, poplar and bass-wood. All these trees attain to a considerable size, and grow, to a greater or less extent, in all parts of Canada except on the coast of Labrador, where the only trees that thrive are the white birch, the fir, spruce, beech, and one of the varieties of pine. The trees of smaller growth common to all the country are the hickory, willow, alder, wild-cherry, dogwood, sassafras, and a few others. The black walnut, tulip-tree and chestnut are confined exclusively to the western peninsula. Oak and elm are more abundant and of better quality in Canada West than in the eastern part of the province; but all the other woods attain greater perfection in Canada East.

It is a lamentable circumstance that materials, which in Europe are so highly esteemed and valued, should in this, the country of their production, be burnt up as fire-wood or left to rot on the ground. Hickory, beech, maple, birch, bass-wood, and white-wood are unsurpassed by any other timbers for their various useful qualities; and yet the exports at Quebec consist almost exclusively of pines, oak, elm, ash and tamarack; the latter having only come into demand within the last few years. As a remedy for this state of things, the attention of parties interested is directed to the recommendations contained in the Hon. Mr. Taché's Report of "Canada at the Universal Exhibition of 1855."†

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* The chief authorities consulted are Dr. Gray's "Manual of the Botany of the Northern United States," and Holtzapffel's Turning and Mechanical Manipulation;" supplemented by the author's practical knowledge of the subject.

† See Canadian Journal for 1857, page 37.

LIST OF WOODS.

N.B.—The relative values of a given bulk, say a cord, of the various descriptions of woods when used as fuel, are stated in reference to shell-bark hickory as the standard, equal to 100.

1. Apple Tree. *Pyrus coronaria.*

Nat. Ord. Rosaceæ. Sub. Ord. Pomaceæ.

Occurs in glades; not very common in Canada. The woods of the wild apple trees are in general pretty hard and close, and of red brown tints, mostly lighter than the hazel nut. The butt of the tree only is used. It is generally very straight and free from knots up to the crown, whence the branches spring. The apple tree splits very well, and is one of the best woods for standing, when it is properly seasoned; it is a clean-working wood, and being harder than chesnut, sycamore or limetree, is better adapted than they for screwed work, but is inferior in that respect to pear tree, which is tougher.

Specific gravity 0.65; weight of cubic foot 40 lbs.

Value for heating purposes 70.

2. White Ash. *Fraxinus americana.*

Nat. Ord. Oleaceæ.

A large forest tree, with grey furrowed bark, smooth greenish-grey branchlets and rusty colored buds; flowers in April and May; occurs commonly in all rich and moist woods. The timber is much valued for its toughness and elasticity; excellent for works exposed to sudden shocks and strains, as the frames of machines, wheel-carriages, agricultural implements, the felloes of wheels, and the inside work of furniture &c.; also for handspikes, billiard cues, fishing rods, hammer handles, rails for chairs, and numerous similar works, which are much stronger when they follow the natural fibre of the wood. The young branches serve for hoops for ships' masts, tubs, churns, &c., also for coarse basket work. There are six species of ash found in America, of which the white ash is by far the most valuable, and is yielded in much greater abundance in Canada than in any other part of the American continent. It grows rapidly, and the young wood is much more valuable than that of old trees. Ash soon rots when exposed to damp, or alternate dryness and moisture; but is tolerably durable in a dry situation.

Specific gravity 0.616; weight of cubic foot 40 lbs.

Value for heating purposes 77.

3. Red Ash. *Fraxinus pubescens.*

Nat. Ord. Oleaceæ.

A smaller tree than the white ash, of much more rare occurrence, and furnishing much less valuable timber, which, however, is applied to similar uses. The usual height is about 60 feet, with a straight trunk covered with bark of a deep brown color.

Specific gravity 0.7; weight of cubic foot 40 lbs.

4. Swamp Ash. *Fraxinus sambucifolia.*

Nat. Ord. Oleaceæ.

Tree rather small, occurs in swamps and along streams and commonly distributed. Timber not of much value; its soft tough wood easily separable into thin layers; used for coarse basket work, chiefly by the Indians.

It resembles the red ash so as often to be confounded with it. The timber possesses the property of being very durable under water.

Specific gravity 0.7; weight of cubic foot 40 lbs.

5. BASSWOOD. *Tilia americana.*
Nat. Ord. Tiliaceæ.

This tree, which belongs to the same genus as that called the lime tree or linden in England, is highly ornamental, and grows abundantly in the rich woods of Western Canada. Flowers in May and June, and attains a great size. The wood is very light colored, firm and close in the grain, and when properly seasoned is not liable to warp or split. It is as soft as deal, and is used in the construction of piano fortes and other musical instruments, and for the cutting boards for curriers, shoemakers, &c., as it does not draw or bias the knife in any direction of the grain nor injure its edge. It turns very cleanly, and is much used for manufacturing bowls, pails, shovels, &c. It is also very suitable for carving, from its open texture and freedom from knots; and, like the white wood, is much used for the pannelling of carriages. The inner bark is very strong and is manufactured into ropes.

Outside wood contains 10 per cent.; inside 4 per cent. potash.

Specific gravity 0.48; weight of cubic foot 26 lbs.

6. WHITE BEECH. *Fagus sylvatica.*
Nat. Ord. Cupuliferæ.

A tree of large dimensions, often rising to the height of 70 or 80 feet. It is distinguished from the red beech by the size, the lighter color of the bark and wood. The wood is also of more difficult cleavage, of greater compactness and strength, and preferable both as timber and for fuel. for which latter purpose the beech is most extensively employed, though it, as well as the maple and hickory, seems to be much too valuable a material for other purposes to be sacrificed to this meaner use.

Specific gravity 0.672; weight of cubic foot 43 lbs.

Value for heating purposes 65.

7. RED BEECH. *Fagus ferruginea.*
Nat. Ord. Cupuliferæ.

Mean dimensions of grown tree, 44 feet high and 27 inches diameter. It occurs commonly in all rich woods, flowering in May. The timber is not so much valued in America as in Europe, being mostly used here for piles in wet foundations, for which it is very well adapted, as also for firewood. It is well adapted, from its uniform texture and closeness of grain, for in-door works, as the frames of machines, common bedsteads, and furniture. It is much used for planes and other tools for carpenters; also for lathe-chucks, keys and cogs of machinery, shoe lasts, toys, brushes, handles, &c. It is also very suitable for carved moulds for picture frames, and for the large wooden letters used in printing. The wood is liable to be attacked by worms when stationary, as in framings; but tools kept in use are not thus injured. It is easily worked, and may be brought to a very smooth surface.

Specific gravity 0.672; weight of cubic foot 41 lbs. Outside wood contains 12 per cent.; heartwood 4 per cent., potash.

8. Blue Beech. *Carpinus americana.*
Nat. Ord. Cupuliferæ.

Called also American Hornbeam, or Water Beech; also, indiscriminately with No. 21, receives the name of Ironwood. Common along streams. Tree 10 to 20 feet high, with ridged trunk, and very hard whitish wood. Excellent for cogs of wheels, and any purpose requiring extreme hardness. Bark, light grey or ash-colored. The generic name *carpinus*, is derived from two Celtic words signifying *wood*, and the *head* implying wood fit for making yokes for cattle, to which use this timber is particularly adapted, being very fine grained, compact and hard. Sometimes called in Canada Yoke Elm. This wood is much esteemed as fuel, though much too valuable for this purpose.

Specific gravity 0.79; weight of cubic foot 47 lbs.

Value for heating purposes 65.

9. White Birch. *Betula alba (populifolia?)*
Nat. Ord. Betulaceæ.

A small slender very graceful tree; grows on poor soils; bark chalk white, separable into thin sheets like paper. Wood, fine-grained and very tough, but not durable. The bark is used by the Indians for their light canoes.

Specific gravity 0.5; weight of cubic foot 32 lbs.

Value for heating purposes 48.

10. Black Birch. *Betula nigra (lenta?)*
Nat. Ord. Betulaceæ.

A rather large tree, with reddish-brown bark, and compact light-colored wood. Occurs chiefly on low river banks. It is an excellent wood for the turner, being light colored, compact and easily worked. It is considerably used in furniture; some of the wood is almost as handsomely figured as Honduras mahogany, and when colored and varnished is not easily distinguished from it. It is not however very durable.

The bark is remarkable for being harder and more durable than the wood itself, being used by the Indians and backwoodsmen as tiles for roofs, shoes, hats, &c. and for canoes and boats. Birch is used extensively by cabinet-makers and carriage builders, and is exported to Europe to a considerable extent. In frames of ships and for parts under water it is more used as it becomes better known. No wood is better adapted to sustain shocks and frictions than birch of good quality. This wood is much used in this country for firewood. Has a most extensive geographical range. Sap saccharine.

Specific gravity 0.65; weight of cubic foot 40 lbs.

Value for heating purposes 68.

11. Butternut. *Juglans cinerea (cathartica?)*
Nat. Ord. Juglandaceæ.

This tree belongs to the same genus with *Juglans nigra*, or the black walnut—which see. Grows commonly in rich woods. Flowers in May, and fruit ripe in September. Grows from 30 to 50 feet high, with grey bark, and widely spreading branches. Wood lighter colored than black walnut, and not so valuable, but

resembles it in most of its qualities. From the bark is extracted an excellent cathartic. I am not aware to what extent walnut timber is exported, but I believe, that were its qualities better known in the mother country and throughout the world, it would be more highly appreciated. It does not work quite so easily as mahogany, but may be brought to a smoother surface, and it shrinks very little. Bark used in dying. Sap saccharine.

Specific gravity 0.426; weight of cubic foot 26 lbs.

Outside wood contains 4.42 per cent. potash; inside wood 1.42 per cent.

Value for heating purposes 51.

12. Cedar. *Thuja occidentalis.*
Nat. Ord. Coniferæ.

The species of cedar occurring in Canada and commonly called the white cedar, forming the "cedar swamps." It grows also on cool rocky banks. Tree, 20 to 50 feet high, straight with recurved branches, yielding a pungent aromatic oil; wood, light and soft and coarse grained, but exceedingly durable. It is much used in the framework of buildings, and the upper timbers of ships. When set in the ground as posts for fences or gates, &c., it is almost indestructible; and is most extensively employed for such purposes. For the same reason it is used for railway ties, but is objectionable on account of its softness and openness of fibre, preventing the firm adhesion of the spike. It is much esteemed for making split laths—known as cypress laths.

Specific gravity 0.458; weight of cubic foot 26 lbs.

Value for heating purposes 51.

13. Cherry. *Padus (Cerasus?) serotina.*
Nat. Ord. Rosaceæ. Sub. Ord. Amygdaleæ.

A fine large tree, growing sometimes to the size of 20 or 24 inches, but more frequently half that size. Grows commonly in all woods. It yields a hard close-grained timber, of a pale red-brown, and is valuable to the cabinet maker; when stained with lime, and oiled or varnished, it closely resembles mahogany. Is much used for common and best furniture, and chairs, &c. The Spanish American cherry-tree is very elastic, and is used for felucca masts. The bark has a strong bitter taste, and has been used in medicine as a tonic.

Specific gravity 0.56; weight of cubic foot 34 lbs.

14. Chesnut. *Castanea vesca.*
Nat. Ord. Cupuliferæ.

A large tree, mean height 80 feet; diameter about 3 feet; is very long-lived and durable. Occurs in rocky or hilly woods; common. Flowers in June and July. It yields a light, coarse-grained wood, not unlike the white oak. The young wood is very elastic, and is used for the rings of ships' masts, hoops for tubs, churns, &c., and the old wood is considered to be rather brittle. The nuts are much esteemed, and those of the American variety are smaller, but much sweeter than the European. The wood is strong, elastic, light and very durable; well adapted for posts set in the earth, &c. A post of chesnut has been taken up out of the ground after having staid there 40 years. Chesnut is easily distinguishable

from oak, in having no large transverse septa—though in every other respect the two woods are remarkably similar in texture and color. Unlike most other woods chesnut, when strained to its breaking pitch, gives way without any warning, more in the manner of metals than woods.

Outside wood contains 4.56 per cent. of potash; inside wood 2.78 per cent.

Specific gravity 0.5; weight of cubic foot 32 lbs.

Value for heating purposes 52.

15. Dogwood. *Cornus florida.*
Nat. Ord. Cornaceæ.

Called also Cornel—the name being derived from the Latin *cornu*, a horn, alluding to the hardness of the wood. Occurs in rocky woods, but rarely in our latitudes, more common southwards. Tree 12 to 30 feet high, flowers in May and June, very showy in flower, and scarcely less so in fruit. Wood very hard, but at the same time tough, and is used for making mallets (being also very heavy). It seems well adapted for many purposes for which boxwood is employed, as scales and measuring rules, paper cutters, &c.

It is so remarkably free from silex that splinters of the wood are used by watchmakers for cleaning out the pivot holes of watches, and by the optician for removing the dust from small deep-seated lenses. The trunk is covered with a peculiarly rough but soft bark, which is extremely bitter, and is used in medicine as a tonic.

Specific gravity 0.78; weight of cubic foot 50 lbs.

Value for heating purposes 75.

16. Rock Elm. *Ulmus racemosa.*
Nat. Ord. Ulmaceæ.

A small or middle-sized tree, with tough reddish wood and a very mucilaginous inner bark; flowers in March and April. Rare and valuable, being held in high esteem for piles. It is not liable to split, and bears the driving of nails and bolts better than any other timber, and is exceedingly durable when constantly wet; it is therefore much used for the keels of vessels, and for wet foundations, water-works, piles, pumps, and boards for coffins; from its toughness, elm is selected for naves of wheels, shells for tackle-blocks and sometimes for gunwales of ships, and also for many purposes of common turnery, as it bears very rough usage without splitting.

There are four species of elms indigenous to North America.

Specific gravity 0.59; weight of cubic foot 36.75 lbs.

17. Swamp Elm. *Ulmus americana.*
Nat. Ord. Ulmaceæ.

Grows in moist woods, especially along rivers in rich soil, and is very common. A large and well known ornamental tree, with spreading branches and drooping branchlets; flowers in April. Timber by no means so valuable as that of rock elm, though partaking of its characteristics. It is much sought on account of the mucilage of the inner bark.

The timber of the elm is perfectly durable when kept dry, but not when ex-

posed to the weather. It twists and warps much in drying, and shrinks very much both in length and breadth. It bears the driving of bolts and nails better than any other timber. The American elm is preferred to the English by wheelwrights.

Specific gravity 0.54; weight of cubic foot 35 lbs.

Value for heating purposes 58.

18. Hawthorn. *Cratægus tomentosa.*
Nat. Ord. Rosaceæ. Sub. Ord. Pomaceæ.

A tall shrub or low tree, growing commonly in thickets, flowering in May and June. None of the thorns exceed the height of 20 feet; consequently, as timber the wood is of little value. The generic name is derived from a Greek word signifying hard, on account of the extreme hardness of the wood of some of the species.

Specific gravity 0.75; weight of cubic foot 46 lbs.

19. Hemlock. *Abies canadensis.*
Nat. Ord. Coniferæ.

A large tree, when young the most graceful of spruces. Occurs in hilly or rocky woods; very common in Canada. It has a light spreading spray and delicate foliage, bright green above, silvery underneath. Timber very coarse grained and poor, but seems well adapted for resisting the effects of moisture, &c., for which reason it is used for railway ties. Attains a height of 70 to 80 feet, with a trunk unusually large in proportion, covered with a rough bark which is used extensively in tanning. This timber is not liable to be attacked by rats or other vermin.

Specific gravity 0.45; weight of cubic foot 26 lbs.

20. Hickory. *Carya alba.*
Nat. Ord. Juglandaceæ.

A large tree, sometimes exceeding three feet in diameter; grows commonly in rich moist woods; flowers in May and sheds nuts in October. The old trunks very rough-barked; wood most valuable as timber and for fuel; while the fruit furnishes the principal hickory nuts of the market. The wood of young trees is exceedingly tough and flexible, and makes excellent handspikes, axe and pickaxe handles, and other works requiring elasticity. The bark of the hickory is recommended by Dr. Bancroft as a yellow dye.

There are seven species indigenous to North America. The wood of this species is also well adapted and sometimes employed for making the keels of vessels. It is the heaviest of all our woods, as will be observed by comparing the specific gravity with that of oak or any others of our list. Hickory contains of potash 20 per cent. in the inside, and 7.5 per cent. outside.

Specific gravity 0.929; weight of cubic foot 58 lbs.

Value for heating purposes 100.

21. Iron Wood, or Hop Hornbeam. *Ostrya virginica.*
Nat. Ord. Cupuliferæ.

A slender tree, occurring not rarely in rich woods, varying from 20 to 40 feet high; bark brownish, and finely furrowed; foliage resembling that of the

beech. Flowers in April and May, and fruit full grown in August, presenting a similar appearance to the hop. Wood very hard and heavy, used for making handspikes and levers, hence the name lever wood, sometimes applied to it. The bark is remarkable for its fine narrow longitudinal divisions.

The heartwood contains not less than 14.55 per cent. of potash.

Specific gravity 0.76; weight of cubic foot 47.5 lbs.

22. Maple. *Acer saccharinum.*

Nat. Ord. Sapindaceæ. Sub. Ord. Aceraceæ.

A large handsome tree; from its elegance, and from its abundance in Canada, the leaf of the maple has been adopted as the national emblem. Occurs abundantly in all rich woods; flowers in April and May, and attains a great size. The timber is very beautiful, and is distinguished as bird's-eye maple, and mottled or curly maple. The latter is principally used for picture frames, the former is full of small knots, that give rise to the name; the grain varies according as the saw has divided the eyes transversely or longitudinally; thus pieces cut out in circular sweeps, as chair backs, sometimes exhibit both the bird's-eye and mottled figures at different parts. Much sugar is made from this variety of maple. The less ornamental portions of the timber are much used for house-carpentry and furniture, while as fuel its quality is unsurpassed.

Potash in outer layers 8.77; in inner 4.21 per cent.

Specific gravity 0.6; weight of cubic foot 38 lbs.

The Curly Maple is properly *Acer rubrum*.

The Soft Maple, *Acer dasycarpum*, is a fine ornamental tree.

Value for heating purposes—hard maple 60; soft 54.

23. White Oak. *Quercus alba.*

Nat. Ord. Cupuliferæ.

A well known and invaluable large tree, widely distributed in all rich woods; flowers in spring and sheds nuts in October. There are not fewer than eighteen species of oak found in North America, but of all these the timber derived from this species approaches nearest to the English oak, which is probably more durable than any other wood which attains the same size. This timber is largely exported to England and the West Indies.

It is a most valuable wood for ship-building, carpentry, frames to machines, and works requiring great strength or exposure to the weather; also for staves of casks, spokes of wheels generally, and naves of waggon wheels, trenails, and numerous small works. On account of its capability of resistance to atmospheric influences it is much used in Canada and the Northern States of the Union for railway ties. Bark useful in tanning and in medicine. This timber is very tough and pliable, but is difficult to work, and is very liable to warp and split in seasoning. It is less durable than British oak, but it is of much quicker growth.

Specific gravity 0.84; weight of a cubic foot 50 lbs., fully seasoned.

Potash obtained from outer wood, 13.41; from heartwood, 9.68 per cent.

Value for heating purposes 81.

24. Red Oak. *Quercus rubra.*

Nat. Ord. Cupuliferæ.

A good sized tree, with reddish, very porous and coarse grained wood, of little value as timber. Flowers and sheds acorns at same seasons as the white oak;

grows in rocky woods—common. It is a lofty, wide-spreading tree, about 70 feet in height, with a diameter of 3 or 4 feet. The bark is extensively used in tanning, and the wood is mostly employed as fuel. This tree grows very rapidly and the timber is light, spongy, and not very durable. Oak timber generally shrinks about one thirty-second part of its original width in seasoning, according to most accurate experiments.

The outside wood yields 20.5 per cent. and the inside 14.79 per cent. of potash.

Specific gravity 0.675; weight of cubic foot 40 lbs.

Value for heating purposes 69.

25. SWAMP OAK. *Quercus discolor.*
Nat. Ord. Cupuliferæ.

A very handsome middle-sized tree; grows abundantly in low alluvial grounds and along streams; light and elegant foliage; the sinuses of the leaves reaching three-fourths of the way to the midrib. The timber is better than that of the red oak, but greatly inferior to the white. The specific name *discolor*, or *bicolor* as it is called by some botanists, is derived from the circumstance of the remarkable appearance presented by the rich and luxuriant foliage, which is smooth and green above, and downy white beneath.

Specific gravity 0.675; weight of cubic foot 40 lbs.

26. YELLOW PINE. *Pinus mitis.*
Nat. Ord. Coniferæ.

A very well-known and valuable tree; grows in dry and sandy soils, common in all parts of the continent. Blossoms developed in spring, and cones commonly maturing in the autumn of the second year; the cones rarely exceed two inches long. Tree from 50 to 60 feet in height, producing a durable, fine-grained, moderately resinous timber, valuable for flooring and many other purposes in house carpentry and in cabinet making. It is also much used in America for ship-building purposes.

Specific gravity 0.52; weight of cubic foot 30 lbs.

Value for heating purposes 54.

27. RED PINE. *Pinus resinosa.*
Nat. Ord. Coniferæ.

The names commonly applied to the various species of pines refer to the colors of their respective timbers, which vary from white to dark red, according to the greater or less quantity of resinous matter or turpentine which they contain. The present species contains more than the yellow and less than the pitch pine. Grows in dry woods commonly; attains a height of from 50 to 80 feet, develops buds and cones same as the yellow pine. This species is commonly, though erroneously, called the Norway pine in this country. Bark smoother and of a clearer red than other pines. This pine affords a fine grained resinous timber, of much strength and durability, and highly valued in architecture. It is a very heavy material, and is apt to become brittle when very dry. On account of the resin which it contains, it is somewhat difficult to plane.

Specific gravity 0.66; weight of cubic foot 40 lbs.

Value for heating purposes 50.

28. White Pine. *Pinus strobus.*
Nat. Ord. Coniferæ.

A fine, tall and handsome tree, occurring in cool and damp woods, northwards; attains frequently a height of from 120 to 160 feet, in a single straight column in the primitive forests, and is invaluable for its soft and light white or yellowish wood, which in large trunks is nearly free from resin. It is largely imported into England, where it is commonly called the "Weymouth pine." This is the most esteemed and generally useful variety of pine timber produced in this country, being admirably adapted for frames of buildings, bridges, and structures of all kinds. The large trunks are in great request for the masts of ships. The facility with which this wood is wrought to the required forms constitutes, together with its durability, its chief value. It is imported into England both in the form of planks and logs, chiefly the latter, which are often more than 2 feet square and 50 feet long.

Specific gravity 0.46; weight of cubic foot 29 lbs.

Value for heating purposes 45.

29. Poplar. *Populus canadensis.*
Nat. Ord. Salicaceæ.

Called also cotton wood. A large tree, 80 feet high and upwards, occurring on the margins of lakes and streams. The timber is soft, light, easy to work, suited to carving, common turnery, and works not exposed to much wear. Is very durable when kept dry, and does not readily take fire. The wooden polishing wheels of the glass grinder are made of horizontal sections of the entire stem, about one inch thick, as from its softness it readily imbibes the polishing materials. The seeds are clothed with a white, cotton like down, which gives name to the tree. Buds sealed against the frost and rains with resin.

The well-known Lombardy poplar, *Populus dilatata* has been introduced from Europe as an ornamental tree, and is found in the vicinity of all old settlements. None of the species of poplars are fit for large timbers.

Specific gravity 0.4; weight of cubic foot 25 lbs.

Value for heating purposes 52.

30. Sassafras. *Sassafras officinale.*
Nat. Ord. Lauraceæ.

Grows abundantly in Canada and in the Western States. Varies in height from 10 to 50 feet. Is of little value as timber, but sometimes used for light ornamental purposes on account of the fragrant odour. Every part of the tree has a pleasant fragrance, and a sweetish, aromatic taste, which is strongest in the bark of the root. These qualities depend upon an essential oil, which may be obtained by distillation, and which is highly valued in medicine, acting as a stimulant to the circulation, especially of the capillaries.

Specific gravity 0.6; weight of cubic foot 37 lbs.

Value for heating purposes 59.

31. Sycamore. *Platanus occidentalis.*
Nat. Ord. Platanaceæ.

Called also plane tree or button-wood, this latter name being derived from the shape of the heads of the flowers, which are produced in May. It occurs on

alluvial river banks westwards, and is a very large and well known tree, with a white bark, separating easily into thin brittle plates. It yields a very clean wood, somewhat softer than beech, but rather disposed to brittleness. The colour of young sycamore is silky white, and of the old, brownish white; the wood of middle age is intermediate in color and the strongest. Some of the pieces are very handsomely mottled. Used in furniture, chiefly for bedsteads, and for piano-fortes and harps; cuts into very good screws, and is used for presses, dairy utensils, windlasses, wheels and blocks.

The plane-tree is by far the largest, (though not the loftiest) tree of the American forests. Trunks are sometimes found in the Western States measuring 40 to 50 feet in circumference.

Specific gravity 0.5; weight of cubic foot 28 lbs.

Value for heating purposes 52.

32. Tamarack. *Larix americana.*
Nat. Ord. Coniferæ.

A slender tree, with heavy, close grained wood and slender horizontal branches: height usually from 20 to 50 feet. Occurs in low wet lands, forming "tamarack swamps." The timber has not until of late years been much esteemed, but next to cedar seems best adapted for underground works. It combines lightness. strength, and durability to a remarkable degree. Called also *Hackmatack* and red spruce. This timber has recently come into great demand in England for many purposes in ship building, combining as it does the most valuable qualities of many others. The best oak is superior to it only for the outside work of a ship where it is exposed to violent shocks or friction. For knees, bends, garlands, &c. of a ship it cannot be surpassed.

Specific gravity 0.6; weight of cubic foot 35 lbs.

33. Black Walnut. *Juglans nigra.*
Nat. Ord. Juglandaceæ.

A large and handsome tree with brown bark, and valuable purplish-brown wood, turning blackish with age. Occurs in rich woods; flowers in May, fruit ripe in October. The timber is fine grained, beautifully veined, and perhaps the most valuable for furniture of any of the North American woods. The wood of another species, *J. regia*, which, however, does not occur in America, is that of which gun stocks are mostly made. The *Juglans nigra* is a common tree in the middle and western States of the Union, but is rather rare in Canada, being confined to the western districts. It rises 60 to 70 feet high, with a diameter of 3 or 4 feet. This wood is very durable and not affected by worms, and is strong, tough, and not liable to split. It is much used for furniture in the form of veneers.

Specific gravity 0.5; weight of cubic foot 30 lbs.

Value for heating purposes 65.

34. White Willow. *Salix alba.*
Nat. Ord. Salicaceæ.

A familiar tree, of rapid growth, attaining a height of 50 to 80 feet; originally from Europe. The timber is, perhaps, the softest and lightest of all woods, for which qualities it is most valuable for some purposes. The color is tolerably white, inclining to yellowish grey. It is planed into chips for hat boxes, baskets,

and wove bonnets. It has been attempted to be used in the manufacture of paper, small branches are used for hoops of tubs, &c.; the larger wood for cricket bats. From its lightness it is sometimes used, in this country, for waggon axles. From the facility with which it may be bent without breaking, it is in demand for boxes for druggists, perfumers, &c.

Specific gravity 0.4; weight of cubic foot 24 lbs.

35. WHITE WOOD. *Liriodendron tulipifera.*
Nat. Ord. Magnoliaceæ.

Called also the Tulip tree, and sometimes, though erroneously, Yellow Poplar. A remarkably beautiful tree, probably, taking all the dimensions, the largest we have in the Province. It attains a height of 140 feet, and the trunk is sometimes found as large as 8 feet in diameter in the Western States. It is extensively diffused, occurring in rich soils, and is most abundant in the western peninsula of Canada. Flowers in May and June. Trunk nearly cylindrical, and of uniform thickness to the height of 60 or 70 feet. But for the difficulty of raising, this would form probably the finest ornamental tree we have. The timber is valuable for building and cabinet purposes, for the latter probably more used than that of any other tree except the white pine. From its cleanness and freedom from knots, and non-liability to warp or shrink, it is much used in railway car and carriage building, chiefly for the pannelling, being both easily wrought and durable and susceptible of a fine polish.

Specific gravity 0.5; weight of cubic foot 30 lbs.

Value for heating purposes, 52.

SELECTED ARTICLES AND TRANSLATIONS.*

REMARKS ON THE FAUNA OF THE QUEBEC GROUP OF ROCKS, AND THE PRIMORDIAL ZONE OF CANADA.

ADDRESSED TO MR. JOACHIM BARRANDE.

BY SIR W. E. LOGAN,
DIRECTOR OF THE GEOLOGICAL SURVEY OF CANADA.

[A question of great geological interest, relating to the occurrence in Canada, of a *Primordial Zone*—synchronous, or partly so, with that recognised by Barrande in Bohemia, by Angelin in the Scandinavian Peninsula, and by the Officers of the British Survey, under Sir Roderick Murchison, in England—has occupied for some time the attention of our leading Geologists. More than two years ago, the able Palæontologist of our Geological Survey, felt constrained to acknowledge, on

* Under this head we intend to insert in the Journal from time to time, original translations of interesting papers, from the *Comptes Rendus*, the *Annales des Sciences Naturelles*, *Poggendorff's Annalen*, and other French and German periodicals; together with occasional articles extracted from the proceedings of the Royal Society and other sources of a less accessible kind.—E. J. C.

fossil evidence, the existence of the upper part of this primordial zone in strata previously referred to a higher place in the series; and this view was much confirmed, as well as forced upon the attention of others, by the subsequent announcement of *Oleni* in strata which seemed to be of the same horizon in Vermont. Descriptions by Prof. Hall, of these Trilobites (then referred to the upper part of the Hudson River group), will be found in Volume IV. of the *Canadian Journal*, page 491. When the knowledge of these forms reached Barrande, he boldly declared his conviction, that too high a position had been accorded to the rocks from which they were procured. If this assumed position could be maintained, the limits of his primordial zone became altogether broken up. Under these circumstances, the accompanying remarks addressed quite recently, by Sir William Logan to Mr. Barrande, and just issued as an independent publication, will be found of no ordinary scientific interest. In Bohemia, the genus *Paradoxides*, and in Sweden and England, *Paradoxides* and *Olenus*, constitute the more typical trilobitic forms of the primordial zone. These types, as yet, have not been recognised in Canada,—although *Paradoxides* has been met with in Newfoundland and Massachusetts, (*Canadian Journal*, Vol. II, New Series, p. 49,) and *Olenus* in Vermont. We may yet expect to find them, however, in the dark shales which underlie the Quebec group; and in this latter, Mr. Billings has already detected the genus *Conocephalites*, a marked type of the Bohemian zone, together with other related forms.—E. J. C.]

MONTREAL, 31st Dec., 1860.

MY DEAR MR. BARRANDE,

I am much indebted to you for your letter of the 6th August, which was accompanied by a copy of your communication to Professor Bronn of Heidelberg, dated 16th July. Agreeably to your request, I took an early opportunity of letting Mr. Hall have a copy of your communication to Professor Bronn, and he received it on the 11th or 12th September.

I am of course aware, from the correspondence you have had with my friend Mr. Billings and myself, how far you are acquainted with our discoveries at Quebec. On two occasions, just previous to the receipt of your last letter to Mr. Billings (received the 8th November), I devoted the short time I could spare from other engagements connected with the Geological Survey, to farther researches at Point Levi. I have satisfied myself, notwithstanding the conglomerate aspect of the bands of rock which contain our new fossils, that the fossils are of the age of the strata. Without entering at present on minute details of structure, I may say that the chief part of the specimens found up to this time, are from two parallel out-crops, which might be taken as representing two distinct layers. If they are such, they are comprehended in a thickness of about 150 feet; but the circumstances of the case, connected with the physical structure, make it probable that

the one band is a repetition of the other through the influence of an anticlinal fold or a dislocation. Both out-crops dip to the south-eastward.

From the more northern out-crop (which we shall call A^2) we have obtained *Orthis* 1, *Leptæna* 1, *Camerella* 1, *Lingula* 2, *Discina* 1, *Agnostus* 3, *Conocephalites* 1, *Arionellus* 4, *Dikelocephalus* 6, *Bathyurus* 4. From the more southern out-crop (which we shall call A^3) we have *Dictyonema* 1, *Orthis* 2, *Leptæna* 1, *Strophomena* 1, *Camerella Cyrtodonta* (?) 1, *Murchisonia* 3, *Pleurotomaria* 7, *Helicotoma* 2, *Straparollus* 2, *Capulus* 2, *Agnostus* 1, *Bathyurus* 4, *Cheirurus* 2, *Amphion*. From a third out-crop, which is still farther southward, and supposed to be another repetition of tne same band (which we shall call A^4) we have *Orthis* 1, *Camerella* 1, *Asaphus* (*A. Illænoides*) 1, *Bathyurus* 1. Tracing A^2 or A^3 round the extremity of a synclinal, and finding occasional indications of the fossils of A^2 and A^3, we arrive at a position on the south side of the synclinal. We shall call the position P. Here the band A^2 or A^3 ends, but a bed of sandstone a little above it is traceable over an anticlinal to a junction with a conglomerate band lower than A^2 or A^3, shewing that A^2 or A^3 must merge into it. Call this A^1. In this we have *Asaphus* (*A. Illænoides*) 1, *Menocephalus* (*M. globosus*) 1. These two series occur in the same fragment of rock. Of all these fossils, 1 *Orthis* is common to A^2, A^3 and A^4 ; 1 *Leptæna*, 1 *Camerella*, 1 *Lingula*, 1 *Agnostus*, and 1 *Bathyurus*, are common to A^2 and A^3 ; 1 *Asaphus* is common to A^3 and A^1.

The dip at P is to the south-eastward, and therefore an inverted dip. North-west of this, and therefore above it, at such a distance as would give a thickness of between 200 or 300 feet, we have a band of shale with nodules of limestone, the nodules made up of other rounded masses in a matrix holding fossils, many of them silicified. From a few of these compound nodules we have obtained *Orthis* 11, *Leptæna* 1 ; this band we shall call B^1. A band like this occurs about half a mile or more to the south-westward. It may be a higher band, or it may be the same band, but we shall call it B^2. From this we obtain *Crinoidæa* (columns) 3, *Orthis* 1, *Camerella* 1, *Nautilus* 1, *Orthoceras* 1, *Leperditia* 1, *Trilobites* (2 genera undetermined) 2. In another position to the south-east, on the south-east of the same anticlinal previously mentioned, we meet with a conglomerate band supposed to be the same as B^2 ; but, in case it should be different, we shall call it

B^2. Here we have *Orthis* 3, *Pleurotomaria* 2, *Murchisonia* 1. *Ophileta* 1, *Helicotoma* 1, *Nautilus* 1, *Maclurea* 1, *Othoceras* 3 or 4, *Cyrtoceras* 1, *Bathyurus* 1, *Illænus* 2, *Asaphus* 1. Of all these fossils,—1 *Orthis* and 1 *Camerella* are common to B^1 and B^2; the same *Orthis* and *Camerella* with 1 *Leptæna* are common to B^1, A^4, A^3 and A^2.

To the north of all these exposures, and on the north-west side of a synclinal running parallel with the synclinal already mentioned, fossils have been obtained in a cliff of about 100 feet, composed of limestone conglomerate, thin bedded limestones and shales. Their equivalence is not yet quite certain, but the strata are supposed to be not far removed from A^1 and A^3. We shall call this cliff A. The fossils from it are *Tetradium* 1, *Orthis* 1, *Trilobite* (genus undescribed) 1, with a great collection of compound *Graptolidæ*, described and being described by Mr. Hall under the genera *Graptolithus* 25, *Retiolites* 1, *Reteograptus* 2, *Phyllograptus* 5, *Dendrograptus* 3, *Thamnograptus* 3, *Dictyonema*, 3.

I have given you these details of localities, because as the subject requires further investigation we do not yet wish to commit ourselves entirely as to the equivalency of separate exposures. But there is no doubt that the whole is one group of strata deposited under one set of alternating circumstances. The whole fauna, as known up to the present time, is composed of—

Articulata	36	species.
Mollusca..............................	55	"
Graptolidæ..........................	42	"
Radiata	4	"
	137	

Of this fauna not one species is found in the Anticosti group, where we have a gradual passage from the fauna of the Hudson River formation to that of the Clinton, and not one in any formation higher than the Chazy, Mr. Billings recognises one species, *Maclurea Atlantica* (Billings) as belonging to the Chazy, and six species as belonging to the Calciferous. They are *Lingula Mantelli* (Billings), *Camerella* undescribed, *Ecculiomphalus* undescribed, *Helicotoma uniangulata* (Hall), *H. perstriata* (Billings), and one remarkable species of an undetermined genus, like a very convex *Cyrtodonta*, which occurs both at Mingan and Point Levi, All of the forms, particularly the trilobites, remind the observer of those figured by Mr. Dale Owen from the oldest

fossilferous rocks of the Mississippi valley, while independent of the six species identical with Chazy and Calciferous forms, there are many others closely allied to those found in the latter formation in Canada.

From the physical structure alone, no person would suspect the break that must exist in the neighbourhood of Quebec, and without the evidence of the fossils, every one would be authorized to deny it. If there had been only one or two species of an ancient type, your own doctrine of colonies might have explained the matter, but this I presume would scarcely be applicable to so many identities in a fauna of such an aspect. Since there must be a break, it will not be very difficult to point out its course and its character. The whole Quebec group, from the base of the magnesian conglomerates and their accompanying magnesian shales to the summit of the Sillery sandstones, must have a thickness of perhaps some 5000 or 7000 feet. It appears to be a great development of strata about the horizon of the Chazy and Calciferous, and it is brought to the surface by an overturn anticlinal fold with a crack and a great dislocation running along the summit, by which the Quebec group is brought to overlap the Hudson River formation. Sometimes it may overlie the overturned Utica formation; and in Vermont, points of the overturned Trenton appear occasionally to emerge from beneath the overlap.

A series of such dislocations traverses eastern North America from Alabama to Canada. They have been described by Messieurs Rogers and by Mr. Safford. The one in question comes upon the boundary of the Province not over a couple of miles from Lake Champlain. From this it proceeds in a gently curving line to Quebec, keeping just north of the fortress; thence it coasts the north side of the Island of Orleans, leaving a narrow margin on the island for the Hudson River or Utica formation. From near the east end of the island it keeps under the waters of the St. Lawrence to within eighty miles of the extremity of Gaspé. Here again it leaves a strip of the Hudson River or Utica formation on the coast.

To the south-east of this line the Quebec group is arranged in long narrow parallel synclinal forms with many overturn dips. These synclinal forms are separated from one another on the main anticlinals by dark grey and even black shales and limestones. These have heretofore been taken by me for shales and limestones of the Hudson River formation, which they strongly resemble, but as they separate the synclinals of the Quebec group, they must now be consid-

ered older. I am not prepared to say that the Potsdam deposit in its typical form of a sandstone is anywhere largely developed above these shales, where the shales are in greatest force. Neither am I prepared to assert its absence, as there are in some places masses of granular quartzite not far removed from the magnesian rocks of the Quebec group, which require farther investigation; but, from finding wind-mark and ripple mark on closely succeeding layers of the Potsdam sandstone where it rests immediately upon the Laurentian series, we know that this arenaceous portion of the formation must have been deposited immediately contiguous to the coast of the ancient Silurian sea, where part of it was even exposed at the ebb of tide. Out in deep water the deposit may have been a black partially calcareous mud, such as would give the shales and limestones which come from beneath the Quebec group.

In Canada no fossils have yet been found in these shales, but the shales resemble those in which *Oleni* have been found in Georgia (Vermont). These shales appear to be interposed between eastward dipping rocks equivalent to the magnesian strata of the Quebec group, and they may be brought up by an overlapping anticlinal or dislocation. We are thus led to believe that these shales and limestones, which may be subordinate to the Potsdam formation, will represent the true primordial zone in Canada.

Mr. Murray has this season ascertained that the lowest rock that is well characterized by its fossils in the neighbourhood of Sault Ste. Marie, near Lake Superior, really belongs to the Birdseye and Black River group, and that it rests on the sandstones of Ste. Marie and Lacloche, the fossiliferous beds at the latter place being tinged with the red colour of the sandstone immediately below them. These underlying Lake Superior rocks may thus be Chazy, Calciferous, and Potsdam, and may be equivalent to the Quebec group and the black colored shales beneath. The Lake Superior group is the upper copper-bearing series of that region, and rests uncomformably upon the lower copper-bearing series, which is the Huronian system. The upper copper-bearing series holds nearly all the metals, including gold, and so does the Quebec group, each making an important metalliferous region. Each when unmetamorphosed holds a vast collection of red colored strata. The want of fossils in the Lake Superior group makes it difficult to draw lines of division, but if any part represents the primordial zone, I should hazard the conjecture that it is the dark coloured slates of Kamanistiquia, which underlie all the red rocks.

Professor Emmons has long maintained, on evidence that has been much disputed, that rocks in Vermont, which in June 1859 I for the first time saw and recognized as equivalent to the magnesian part of the Quebec group, are older than the Birdseye formation; the fossils which have this year been obtained at Quebec pretty clearly demonstrate that in this he is right. It is at the same time satisfactory to find that the view which Mr. Billings expressed to you in his letter of the 12th July, to the effect that the Quebec trilobites appeared to be about the base of the second fauna, should so well accord with your opinions; and that what we were last spring disposed to regard at Georgia, (Vermont) as a colony in the second fauna, should so soon be proved, by the discoveries at Quebec, to be a constituent part of the primordial zone.

I am, my dear Mr. Barrande,

Very truly yours,

W. E. LOGAN.

Mr. Joachim Barrande,
Rue Mézière, No. 6,
Paris.

ON A SECOND INSTANCE OF THE REPRODUCTION OF THE OSTRICH IN EUROPE.

COMMUNICATION ADDRESSED TO M. IS. GEOFFROY ST. HILAIRE, BY PRINCE DEMIDOFF.

(*Translated from the Comptes Rendus, of August* 17, 1860.)

My zoological establishment at San-Donato, has just afforded me a second example of the reproduction of the ostrich; and, this time, under conditions which speak decisively for the acclimation of this beautiful and useful bird. A pair which gave me two young ostriches in 1859, has just produced six more; and I think it a duty to indicate the phases of the incubation: since, with regard to novel facts, the least details are not without their interest.

A severe accident, which occurred to the male bird during the month of March, made us apprehensive of his loss. The ostrich drove its head with such force through the narrow bars of the fence which surrounds the park, that it was unable to withdraw it without causing a large wound upon its neck. Immediate assistance was

rendered to the poor bird; and, although in general very quarrelsome during the breeding season, it suffered itself to be handled with great patience. Whilst its sickness lasted, it abstained from all food; but at the end of three weeks, it became perfectly restored to health, and sought its companion with renewed ardour.

The first egg was laid on the 11th of May, and, afterwards, the laying went on regularly, at the rate of an egg every other day, up to the 31st. On that day, after having deposited the eleventh egg, the female sat for a couple of hours. The male then replaced her, but only up to the night.

On the 1st of June, the female sat from 8 A. M., to 3 P. M. The male then took her place, and continued to sit uninterruptedly until 10 A. M. on the 2nd. From this latter to the 3rd, the same course was followed.

On the 3rd, the nest received a twelfth egg; a thirteenth, on the 4th; and a fourteenth on the 5th—at which date the laying ceased.

Up to the 23rd of June, the incubation continued in the manner already indicated, the female sitting five hours, from 10 A. M. to 3 P. M., and the male continuing the incubation through a long sitting of nineteen hours, or until 10 o'clock the next morning.

Since the 14th of June, the temperature of the air had experienced several abrupt changes. Almost every day, a storm, accompanied by wind and rain, broke over the park. On the 17th there was a complete hurricane, with claps of thunder. At the first premonitory signs of this tempest, the female placed herself beside the male to assist him in covering the eggs, and, contrary to her usual custom, she remained on the nest until eight o'clock the next morning. As to the male bird, he did not quit his post before three in the afternoon: so that he remained without taking nourishment for twenty-four hours.

The weather again cleared up. On the 23rd of June, about three o'clock in the morning, M. Desmeure, who has charge of my establishment, was attracted by a peculiar little cry, which he knew, by the experience of the past year, to signalize the hatching of a young bird. The little-one was already running around its male parent, but the latter did not quit the nest during the entire day. M. Desmeure having observed the young bird to wander to some distance, and become entangled in a bush, made up his mind to enter the park. He replaced the "little stranger" under the wing of the male ostrich, and took advantage of the occasion to put within its reach a sufficient

amount of food and water. Neither the male nor the female seemed to be disturbed by his presence. At this moment, three more young birds appeared, and precipitating themselves from the nest, commenced to peck at the food. This, as on the former occasion, was composed of a paste of finely chopped eggs, salad, and bread-crumbs.

On the 24th, the male still continued to sit, and the four young ones walked about with the mother. About two o'clock, however, he arose, and then a fifth young one was discovered. The latter quickly commenced to run about, pecking here and there. During twenty minutes, the male ostrich walked to and fro, took food, and caressed his little-ones. He then returned to the nest, where the female had replaced him. At night, the five young ones sheltered themselves under his wings.

On the 26th, at day-break, the young ostriches began to follow the female, who presided at a copious repast, of which she took her share. The male having left the nest for an instant, M. Desmeure went to inspect the eggs, and noticed a violent commotion in one of them. Knowing that this arose from the vain efforts of an imprisoned bird to get free, he opened the egg at the proper spot, and replaced it in the nest. A few moments after the return of the male, the young bird appeared. More feeble than the others, it could scarcely keep upon its legs, and rolled about, at first, like a ball; but in the course of a few hours it followed its elder brethren, pecking right and left.

From this time, the nest was pretty well abandoned. The male only took irregular sittings, and appeared restless and uneasy. This was evidently the effect of a storm, which was gathering in the atmosphere, and which burst upon San-Donato with extreme violence. Lightning-rods within a distance of about 164 yards from the ostrich-park, were twice struck. The brood, with the parent birds, having sought refuge within the covered shed appropriated to them, the eight eggs, which remained, were taken there, and placed in a nest of sand that had been prepared in case of any emergency requiring it; but the ostriches would have nothing to do with them. From the moment in which the storm broke over the park, the eggs were definitely deserted. Five of these were well advanced towards hatching, the rest were clear.

This second example of the reproduction of the ostrich, although presenting in its details the same general features as in the first recorded case, offers, nevertheless, certain traits by which it may be

legitimately predicted that domestication will go on side by side with reproduction. On this latter occasion, for instance, the pair exhibited so little of their former savage disposition, that I was able during six or seven days together, to pass a quarter of an hour or so in the park, close to the nest, without disturbing the birds in any way. The one which sat betrayed no signs of agitation; and the other approached me evidently with pacific intentions. M. Desmeure, who has displayed on this occasion the same zeal as before, and who did not, so to say, lose sight of the ostriches, thinks that after three or four broods have been raised, this bird will reproduce itself as readily, and with as little trouble, as the common fowls of the farm-yard.

The two ostriches born in 1859, are magnificent birds, and are almost as large as their parents. Nothing as yet indicates their sex this only manifesting itself at the adult age.

I have just learned that the young bird which came last, and, in a manner, artificially, into the world, did not live beyond a few days. Only five young ostriches therefore remain as the produce of this year, but these are perfectly well-formed, and they commence already to assume the shape and character of their race, of which, it should be stated, not the slightest sign was apparent at their birth. On quitting the egg, for example, the young ostrich has both the neck and feet remarkably short.

In presenting the above communication of Prince Demidoff, M. Isidore Geoffroy-Saint-Hilaire re-called the fact, that two years previously he had had the honour to communicate a note, by M. le Maréchal Vaillant, on a reproduction of the ostrich obtained by M. Hardy, at Hamma in Algeria. M. Hardy has had since a great number of young broods, some of which have produced a second generation. Before the broods obtained, however, at Prince Demidoff's establishment at San-Donato, by the care of M. Desmeure, not a single example was known of the reproduction of the ostrich in Europe. In the north of France, and especially in the menagerie of the Paris Museum, ostrich eggs are frequently laid, but these; hitherto, have always been unproductive. In the south of France, at Méze near Montpellier, M. Moquin-Tandon proved in one case the fecundation of the egg, but this did not become hatched.

When M. Geoffroy-Saint-Hilaire, consequently, called attention to the advantages which might accrue from the acclimation in Europe of

the so-called *oiseaux de boucherie,* he did not feel warranted in including the African ostrich amongst these, but confined himself to the recommendation of the Nandu, and of the Dromaius or Emeu of Australia—genera belonging to climates much less warm than that of Africa. As to the Emeu or so-called Cassowary of Australia, not only is that bird able to support the climate of France, but no species appears to be better fitted to withstand its changes. The Emeu is so robust and hardy, that it has been seen in the menagerie of the Paris Museum, to remain out of doors from one end of the year to the other, at night as well as during the day, without ever seeking the shelter of its lodge, even during the most rigorous weather. More than once, indeed, it has let itself, literally, be buried in the snow, without appearing to suffer from this in the least degree.

With regard to the facts also, mentioned in the interesting communication of Prince Demidoff, M. Geoffroy-Saint-Hilaire stated, that, likewise in Algeria, M. Hardy had seen the male ostrich occupy itself with the incubation of the eggs, much more fully than the female. On one occasion, even, the female limited her duties principally to the bare act of turning the eggs carefully over in the nest during the temporary absence of the male. At the Paris Museum, where the Emeu has re-produced itself, and where M. Florent Prevost noted down with the greatest care all the attendant circumstances, the male Emeu alone hatched the eggs, and took care of the young birds. The part of the female in the case recorded, was confined to the simple laying of the eggs. E. J. C.

NOTE ON THE QUESTION—CAN SODA REPLACE POTASH AS A MANURE.

BY M. GEORGE VILLE.

[*Translated from the Comptes Rendus of September 17th, 1860.*]

For some years past, enormous and constantly increasing quantities of nitrate of soda from Peru, have been consumed for agricultural purposes in Great Britain. The good effects of this salt, attested at present by the most extended employment, were originally made known by the able researches of M. Kuhlmann,* and by those, more

* Expériences chimiques et agronomiques: 1847.

theoretical in their character, of MM. Bineau, Bonssingault, and G. Ville. Amongst the publications which have largely contributed also to our knowledge of the practical utility of nitrate of soda, we must not forget the numerous and very remarkable papers of Dr. Pusey.*

Chemists and agriculturists, men of science, and practical farmers, all seem to be at present unanimous in ranking nitrate of soda as one of the most efficaceous agents of vegetable production.

Before the unfortunate Leblanc had discovered the admirable process by which soda is readily obtained from sea-salt, advantage was taken, in the manufacture of this useful alkali, of the property possessed by marine plants of extracting and secreting in their tissues the soda contained in sea-water. The combustion of these plants furnishes an ash, of which carbonate of soda is one of the principal components. Amongst the vegetable matters fitted for the extraction of this alkali, the ash of the Barille, a plant cultivated on the coasts of Spain, yields from 20 to 50 *per cent.* of carbonate of soda. Although less rich in alkalies, the ash of the varech affords also considerable quantities. The abundance of soda in the ashes of these vegetables, joined to the disappearance of plants containing soda in the interior of continents (at least when the soil is destitute of salt,) indicates clearly the fact that soda is essential to their existence. Now, considering the close relationship between soda and potash, it is not without interest to inquire how far these alkalies are capable of replacing one another; and, in addition, whether a substitution of this kind affects in any way the development of vegetable life.

M. Payen relates that the leaves and branches of *Mesambrianthemum cristallinum,* collected at the Island of Teneriffe for the extraction of soda, are dotted with glands containing a solution of the oxalate of that alkali; whilst, in passing inland from the coast, these glands are found to contain oxalate of potash.

The venerable M. de Gasparin cites also, another vegetable species, in which potash appears to replace soda in a still more complete manner, without detriment to the vigour of the plant. This is the *Salsola tragus,* collected as a "soda plant," in the district between Frontignan and Aigues-Mortes. This species extends far up the valley of the Rhone, and, according to M. de Gasparin,† is of equally vigorous growth in its most inland station, as in the neighbourhood of

* Journal of the Royal Agricultural Society of England, vols. xiii, xiv, and xv.

† Cours d'Agriculture; 3e. édition, T. 1, p. 108.

the sea. Only, in the former, the plant contains potash—the soda having entirely disappeared.

From these two examples, consequently, it would seem that potash can sometimes replace soda, without ill effects accruing from the substitution. The inverse of this problem remains now to be considered: *i.e.*, the question as to whether soda can be substituted for potash in certain vegetables, and what may be the effects of this replacement. With regard to wheat, the answer is complete and peremptory. Soda employed to the total exclusion of potash, hinders most materially the development of the plant, and greatly lessens the amount of grain. In support of this assertion, I may cite two experiments, performed under different conditions, and confirmatory one of the other.

A soil (that of the Landes) naturally free from potash, was employed in these experiments. It was treated with 10 grammes of phosphate of lime, and 0.110 grm. of nitrogen—present, in the one case in nitrate of potash, and in the other in nitrate of soda.

With phosphate of lime and nitrate of potash, an active and flourishing growth takes place. The wheat succeeds admirably: the stalks are firm, the ears well formed, and filled with large and heavy grains.

On the other hand, when the nitrate of potash is replaced by nitrate of soda, the vegetation has quite another character: the growth is slow, the stalks incline in all directions, and the ears, when formed, contain but a few grains, and those of poor quality.

These statements are confirmed by the following table, embodying the results of the experiments in question. The amount of wheat sown in each experiment was 20 grains.

A.		*B.*	
Soil treated with phosphate of lime and nitrate of potash:		Soil treated with phosphate of lime and nitrate of soda:	
Straw and roots.12gr. 14	14·92.	Straw and roots...7gr.085	7·41.
140 grains of wheat.2gr.78		20 grains of wheat.0gr.325	

The weight obtained in the first experiment, it will be observed, almost doubles that obtained in the second. Soda, consequently, cannot without detriment be substituted for potash.

Another set of experiments was instituted by adding four grammes of silicate of potash to each of the mixtures described above. This had the effect of equalizing the results. The addition of the silicate

rendered the nitrate of soda almost as efficaceous as the nitrate of potash. If it be asked, why, under these conditions the two nitrates produce the same effects or nearly so—we reply, because they act, in this case, simply by their nitrogen; the soil being already liberally supplied with potash by the addition of the silicate.

The following table exhibits these results, and shews the amount of influence due under these new conditions to the potash of the nitrate. The grains of wheat sown, amounted, as before, to twenty.

A.		*B.*	
Soil treated with phosphate of lime, nitrate of potash, and silicate of potash.		Soil treated with phosphate of lime, nitrate of soda, and silicate of potash.	
I.		I.	
Straw and roots...17gr.70	grms.	Straw and roots...15gr.25	grms.
215 grains of wheat..5·35	23·05	220 grains of wheat..4·45	19.70
II.		II.	
Straw and roots...17gr.08	21·73	Straw and roots...16gr.14	grms.
207 grains of wheat..4·65		201 grains of wheat.4gr.90	21.04
Mean.		*Mean.*	
Straw and roots...17gr.39	grms.	Straw and roots...15gr.70	grms.
211 grains of wheat..5·00	22·39	210 grains of wheat..4·67	20·37

From the experiments described above, the following conclusions may be deduced:

1. So far as regards wheat, soda cannot be employed as a substitute for potash: nitrate of soda associated with phosphate of lime, constitutes a manure of little efficacy.

2. An addition of potash imparts to the mixture an immediate activity.

3. If in practice, nitrate of soda has shown itself to be beneficial, this arises from the natural presence of potash in the soil.

E. J. C.

"NOTE ON REGELATION."

BY MICHAEL FARADAY, D.C.L., F.R.S., ETC.

[*From the Proceedings of the Royal Society: Read April 26th, 1860.*]

The philosophy of the phenomenon now understood by the word Regelation is exceedingly interesting, not only because of its relation to glacial action under natural circumstances, as shown by Tyndall and others, but also, and as I think especially, in its bearings upon molecular action; and this is shown, not merely by the desire of different philosophers to assign the true physical principle of action, but also by the great differences between the views which they have taken.

Two pieces of thawing ice, if put together, adhere and become one; at a place where liquefaction was proceeding, congelation suddenly occurs. The effect will take place in air, or in water, or in vacuo. It will occur at every point where the two pieces of ice touch; but not with ice below the freezing point, *i. e.* with dry ice, or ice so cold as to be everywhere in the solid state.

Three different views are taken of the nature of this phenomenon. When first observed in 1850, I explained it by supposing that a particle of water, which could retain the liquid state whilst touching ice only on one side, could not retain the liquid state if it were touched by ice on both sides; but became solid, the general temperature ramaining the same.* Professor J. Thompson, who discovered that pressure lowered the freezing-point of water,† attributed the regelation to the fact that two pieces of ice could not be made to bear on each other without pressure; and that the pressure, however slight, would cause fusion at the place where the particles touched, accompanied by relief of the pressure and resolidification of the water at the place of contact, in the manner that he has fully explained in a recent communication to the Royal Society‡. Professor Forbes assents to neither of these views; but admitting Person's idea of the gradual liquefaction of ice, and assuming that ice is essentially colder than ice-cold water, *i. e.* the water in contact with

* Researches in Chemistry and Physics, 8vo. pp. 373, 378.

† Mousson says that a pressure of 13,000 atmospheres lowers the temperature of freezing from 0° to −18° C.

‡ Royal Society Proceedings, vol. x. p. 152.

it, he concludes that two wet pieces of ice will have the water between them frozen at the place where they come into contact.*

Though some might think that Professor Thompson, in his last communication, was trusting to changes of pressure and temperature so inappreciably small as to be not merely imperceptible, but also ineffectual, still he carried his conditions with him into all the cases he referred to, even though some of his assumed pressures were due to capillary attraction, or to the consequent pressure of the atmosphere, only. It seemed to me that experiment might be so applied as to advance the investigation of this beautiful point in molecular philosophy to a further degree than has yet been done; even to the extent of exhausting the power of some of the principles assumed in one or more of the three views adopted, and so render our knowledge a little more defined and exact than it is at present.

In order to exclude all pressure of the particles of ice on each other due to capillary attraction or the atmosphere, I prepared to experiment altogether under water; and for this purpose arranged a bath of that fluid at 32° F. A pail, surrounded by dry flannel, was placed in a box; a glass jar, 10 inches deep and 7 inches wide, was placed on a low tripod in the pail; broken ice was packed between the jar and the pail; the jar was filled with ice-cold water to within an inch of the top; a glass dish filled with ice was employed as a cover to it, and the whole enveloped with dry flannel. In this way the central jar, with its contents, could be retained at the unchanging temperature of 32° F. for a week or more; for a small piece of ice floating in it for that time was not entirely melted away. All that was required to keep the arrangement at the fixed temperature, was to renew the packing ice in the pail from time to time, and also that in the basin cover. A very slow thawing process was going on in the jar the whole time, as was evident by the state of the indicating piece of ice there present.

Pieces of good Wenham-lake ice were prepared, some being blocks three inches square, and nearly an inch thick, others square prisms four or five inches long: the blocks had each a hole made through them with a hot wire near one corner; woollen thread passed through these holes formed loops, which, being attached to pieces of lead, enabled me to sink the ice entirely under the surface of the ice-cold water. Each piece was thus moored to a particular place, and, be-

* Proceedings of the Royal Society of Edinburgh, April 19, 1858.

cause of its buoyancy assumed a position of stability. The threads were about 1½ inch long, so that a piece of ice, when depressed sideways and then left to itself, rose in the water as far as it could, and into its stable position, with considerable force. When, also, a piece was turned round on its loop as a vertical axis, the torsion force tended to make it return in the reverse direction.

Two similar blocks of ice were placed in the water with their opposed faces about two inches apart; they could be moved into any desired position by the use of slender rods of wood, without any change of temperature in the water. If brought near to each other and then left unrestrained, they separated, returning to their first position with considerable force. If brought into the slightest contact, regelation ensued, the blocks adhered, and remained adherent notwithstanding the force tending to pull them apart. They would continue thus, even for twenty-four hours or more, until they were purposely separated, and would appear (by many trials) to have the adhesion increased at the points where they first touched, though at other parts of the contiguous surfaces a feeble thawing and dissecting action went on. In this case, except for the first moment and in a very minute degree, there was no pressure either from capillary action or any other cause. On the contrary, a tensile force of considerable amount was tending all the time to separate the pieces of ice at their points of adhesion; where still, I believe, the adhesion went on increasing—a belief that will be fully confirmed hereafter.

Being desirous of knowing whether anything like soft adhesion occurred, such as would allow slow change of position without separation during the action of the tensile force, I made the following arrangements. The blocks of ice being moored by the threads fastened to the lowest corners, stood in the water with one of the diagonals of the large surfaces vertical; before the faces were brought into contact, each block was rotated 45° about a horizontal axis, in opposite directions, so that when put together, they made a compound block, with horizontal upper edges, each half of which tended to be twisted upon, and torn from the other. Yet by placing indicators in holes previously made in the edges of the ice, I could not find that there was the slightest motion of the blocks in relation to each other in the thirty-six hours during which the experiment was continued. This result, as far as it goes, is against the necessity of pressure to

regelation, or the existence of any condition like that of softness or a shifting contact; and yet I shall be able to show that there is either soft adhesion or an equivalent for it, and from that state draw still further cause against the necessity of pressure to regelation.

Torsion force was then employed as an antagonist to regelation. The ice-blocks, being separate, were adjusted in the water so as to be parallel to each other, and about 1½ inch apart. If made to approach each other on one side, by revolution in opposite directions on vertical axes, a piece of paper being between to prevent ice contact, the torsion force set up caused them to separate when left to themselves; but if the paper were away and the ice pieces were brought into contact, by however slight a force, they became one, forming a rigid piece of ice, though the strength was, of course, very small, the point of adhesion and solidification being simply the contact of two convex surfaces of small radius. By giving a little motion to the pail, or by moving each piece of ice gently in the water with a slip of wood, it was easy to see that the two pieces were rigidly attached to each other; and it was also found that, allowing time, there was no more tendency to a changing shape here than in the case quoted above; if now the slip of wood were introduced between the adhering pieces of ice, and applied so as to aid the torsion force of one of the loops, *i. e.* to increase the separating force, but unequally as respects the two pieces, then the congelation at the point of contact would give way, and the pieces of ice would move in relation to each other. Yet they would not separate; the piece unrestrained by the stick would not move off by the torsion of its own thread, though, if the stick were withdrawn, it would move back into its first attached position, pulling the second piece with it; and the two would resume their first associated form, though all the while the torsion of both loops was tending to make the pieces separate.

If when the wood was applied to change the mutual position of the two pieces of ice, without separating them, it were retained for a second undisturbed, then the two pieces of ice became fixed rigidly to each other in their new position, and maintained it when the wood was removed, but under a state of restraint; and when sufficient force was applied, by a slight tap of the wood on the ice to break up the rigidity, the two pieces of ice would rearrange themselves under the torsion force of their respective threads, yet remain

united; and, assuming a new position, would, in a second or less, again become rigid, and remain inflexibly conjoined as before.

By managing the continuous motion of one piece of ice, it could be kept associated with the other by a flexible point of attachment for any length of time, could be placed in various angular positions to it, could be made (by retaining it quiescent for a moment) to assume and hold permanently any of these positions when the external force was removed, could be changed from that position into a new one, and, within certain limits, could be made to possess at pleasure, and for any length of time, either a flexible or a rigid attachment to its associated block of ice.

So, regelation includes a flexible adhesion of the particles of ice, and also a rigid adhesion. The transition between these two states takes place when there is no external force like pressure tending to bring the particles of ice together, but, on the contrary, a force of torsion is tending to separate them; and, if respect be had to the mere point of contact on the two rounded surfaces where the flexible adhesion is exercised, the force which tends to separate them may be esteemed very great. The act of regelation cannot be considered as complete until the junction has become rigid; and therefore I think that the necessity of pressure for it is altogether excluded. No external pressure can remain (under the circumstances) after the first rigid contact is broken. All the forces which remain tend to separate the pieces of ice; yet the first flexible adhesions, and all the successive rigid adhesions which are made to occur, are as much effects of regelation as those which occur under the greatest pressure.

The phenomenon of flexible adhesion under tension looks very much like sticking and tenacity; and I think it probable that Professor Forbes will see in it evidence of the truth of his view. I cannot, however, consider the fact as bearing such an interpretation; because I think it impossible to keep a mixture of snow and water for hours and days together without the temperature of the mixed mass becoming uniform; which uniformity would be fatal to the explanation. My idea of the flexible and rigid adhesion is this:— Two convex surfaces of ice come together; the particles of water nearest to the place of contact, and therefore within the efficient sphere of action of those particles of ice which are on both sides of them, solidify; if the condition of things be left for a moment, that the heat evolved by the solidification may be conducted away and dis-

persed, more particles will solidify, and ultimately enough to form a fixed and rigid junction, which will remain until a force sufficiently great to break through it is applied. But if the direction of the force resorted to can be relieved by any hinge-like motion at the point of contact, then I think that the union is broken up among the particles on the opening side of the angle, whilst the particles on the closing side come within the effectual regelation distance; regelation ensues there and the adhesion is maintained, though in an apparently flexible state. The flexibility appears to me to be due to a series of ruptures on one side of the centre of contact, and of adhesion on the other,—the regelation, which is dependent on the vicinity of the ice surfaces, being transferred as the place of efficient vicinity is changed. That the substance we are considering is as brittle as ice, does not make any difficulty to me in respect of the flexible adhesion; for if we suppose that the point of contact exists only at one particle, still the angular motion at that point must bring a second particle into contact (to suffer regelation) before separation could occur at the first; or if, as seems proved by the supervention of the rigid adhesion upon the flexible state, many particles are concerned at once, it is not possible that all these should be broken through by a force applied on one side of the place of adhesion, before particles on the opposite side should have the opportunity of regelation, and so of continuing the adhesion.

It is not necessary for the observation of these phenomena that a carefully-arranged water-vessel should be employed. The difference between the flexible and rigid adhesion may be examined very well in air. For this purpose, two of the bars of ice before spoken of, may be hung up horizontally by threads, which may be adjusted to give by torsion any separating force desired; and when the ends of these bars are brought together, the adhesion of the ice, and the ability of placing these bars at any angle, and causing them to preserve that angle by the rigid adhesion due to regelation, will be rendered evident; and though the flexible adhesion of the ice cannot in this way be examined alone, because of the capillary attraction due to the film of water on the ice, yet that is easily obviated by plunging the pieces into a dish of water at common temperatures, so that they are entirely under the surface, and repeating the observations there. All the important points regarding the flexible and rigid junction of ice due to regelation, can in this way be readily investigated.

It will be understood that, in observing the flexible and rigid state of union, convex surfaces of contact are necessary, so that the contact may be only at one point. If there be several places of contact, apparent rigidity is given to the united mass, though each of the places of contact might be in a flexible and, so to say, adhesive condition. It is not at all difficult to arrange a convex surface so that, bearing at two places only on the sides of a depression, it should form a flexible joint in one direction, and a rigid attachment in a direction transverse to the former.

It might seem at first sight as if the flexible adhesion of the ice gave us a point to start from in the further investigation of the principle of pressure. If the application of pressure causes ice to freeze together, the application of tension might be expected to produce the contrary effect, and so cause liquidity and separation at the flexible joint. This, however does not necessarily follow; nor do I intend to consider what might be supposed to take place whilst theoretically contemplating that case. I think the changes of temperature and pressure are too infinitesimal to go for anything; and in illustration of this, will describe the following experiment. Wool is known to adhere to ice in the manner, as I believe, of regelation. Some woollen thread was boiled in distilled water, so as thoroughly to wet it. Some clean ice was broken up small and mixed with water, so as to produce a soft mass, and, being put into a glass jar clothed in flannel that it might keep for some hours, had a linear depression made in the surface, so as to form a little ice-ditch filled with water; in this depression some filaments of the wetted wool were placed, which, sinking to the bottom, rested on the ice only with the weight which they would have being immersed in water; yet in the course of two hours these filaments were frozen to the ice. In another case, a small loose ball of the same boiled wool, about half an inch in diameter, was put on to a clean piece of ice; that into a glass basin; and the whole wrapped up in flannel and left for twelve hours. At the end of that time it was found that thawing had been going on, and that the wool had melted a hole in the ice, by the heat conducted through it to the ice from the air. The hole was filled with the water and wool, but at the bottom some fibres of the wool were frozen to the ice.

Is this remarkable property peculiar to water, or is it general to all bodies? In respect of water it certainly seems to offer us a glimpse

into the joint physical action of many particles, and into the nature of cohesion in that body when it is changing between the solid and liquid state. I made some experiments on this point. Bismuth was melted and kept at a temperature at which both solid and liquid metal could be present; then rods of bismuth were introduced, but when they had acquired the temperature of the mixed mass no adhesion could be observed between them. By stirring the metal with wood, it was easy to break up the solid part into small crystalline granules; but when these were pressed together by wood under the surface, there was not the slightest tendency to cohere, as hail or snow would cohere in water. The same negative result was obtained with the metals tin and lead. Melted nitre appeared at times to show traces of the power; but, on the whole, I incline to think the effects observed resulted from the circumstance that the solid rods experimented with had not acquired throughout the fusing temperature. Nitre is a body which, like water, expands in solidifying; and it may possess a certain degree of this peculiar power.

Glacial acetic acid is not merely without regelating force, but actually presents a contrast to it. A bottle containing five or six ounces, which had remained liquid for many months, was at such a temperature that being stirred briskly with a glass rod, crystals began to form in it; these went on increasing in size and quantity for eight or ten hours. Yet all that time there was not the slightest trace of adhesion amongst them, even when they were pressed together; and as they came to the surface, the liquid portion tended to withdraw from the faces of the crystals; as if there were a disclination of the liquid and solid parts to adhere together.

Many salts were tried (without much or any expectation),—crystals of them being brought to bear against each other by torsion force, in their saturated solutions at common temperatures. In this way the following bodies were experimented with:—Nitrates of lead, potassa, soda; sulphates of soda, magnesia, copper, zinc; alum; borax; chloride of ammonium; ferro-prussiate of potassa; carbonate of soda; acetate of lead; and tartrate of potassa and soda; but the results with all were negative.

My present conclusion therefore is that the property is special for water; and that the view I have taken of its physical cause does not appear to be less likely now than at the beginning of this short

investigation, and therefore has not sunk in value among the three investigations given.

Dr. Tyndall added to one of his papers*, a note of mine "On ice of irregular fusibility" indicating a cause for the difference observed in this respect in different parts of the same piece of ice. The view there taken was strongly confirmed by the effects which occurred in the jar of water at constant temperature described in the beginning of the preceding pages, where, though a thawing process was set up, it was so slow as not dissolve a cubic inch of ice in six or seven days. The blocks retained entirely under water for several days, became so dissected at the surfaces as to develop the mechanical composition of the masses, and to show that they were composed of parallel layers about the tenth of an inch thick, of greater and lesser fusibility, which layers appear, from other modes of examination, to have been horizontal in the ice whilst in the act of formation. They had no relation to the position of the blocks in the water of my experiments, or to the direction of gravity, but had a fixed position in relation to each piece of ice.

ADDENDUM:—The following method of examining the regelation phenomena above described may be acceptable. Take a rather large dish of water at common temperatures. Prepare some flat cakes or bars of ice, from half an inch to an inch thick; render the edges round, and the upper surface of each piece convex, by holding it against the inside of a warm saucepan cover, or in any other way. When two of these pieces are put into the water they will float, having perfect freedom of motion, and yet only the central part of the upper surface will be above the fluid; when, therefore, the pieces touch at their edges, the width of the water-surface above the place of contact may be two, three, or four inches, and thus the effect of capillary action be entirely removed. By placing a plate of clean dry wax or spermaceti upon the top of a plate of ice, the latter may be entirely submerged, and the tendency to approximation from capilliary action converted into a force of separation. When two or more of such floating pieces of ice are brought together by contact at some point under the water, they adhere; first with an apparently flexible, and then with a rigid adhesion. When five or six pieces are grouped in a contorted shape, as an S, and one end piece be moved carefully, all will move with it rigidly; or, if the force be enough to break through

* Philosophical Transactions, 1858, p. 228.

the joint, the rupture will be with a crackling noise, but the pieces will still adhere, and in an instant become rigid again. As the adhesion is only by points, the force applied should not be either too powerful or in the manner of a blow. I find a piece of paper, a small feather, or a camel-hair brush applied under the water very convenient for the purpose. When the point of a floating, wedge-shaped piece of ice is brought under water against the corner or side of another floating piece, it sticks to it like a leech; if, after a moment, a paper edge be brought down upon the place, a very sensible resistance to the rupture at that place is felt. If the ice be replaced by like rounded pieces of wood or glass, touching under water, nothing of this kind occurs, nor any signs of an effect that could by possibility be referred to capillary action; and finally, if two floating pieces of ice have separating forces attached to them, as by threads connecting them and two light pendulums, pulled more or less in opposite directions, then it will be seen with what power the ice is held together at the place of regelation, when the contact there is either in the flexible or rigid condition, by the velocity and force with which the two pieces will separate when the adhesion is properly and entirely overcome.

NOTES ON THE APPARENT UNIVERSALITY OF A PRINCIPLE ANALOGOUS TO REGELATION, ON THE PHYSICAL NATURE OF GLASS, AND ON THE PROBABLE EXISTENCE OF WATER IN A STATE CORRESPONDING TO THAT OF GLASS.

BY EDWARD W. BRAYLEY, ESQ., F.R.S., &C.

[*From the Proceedings of the Royal Society; Read April 26, 1860.*]

1. Recent experimental investigations, and the reasoning founded upon them, have elevated the designation of an observed property of ice to the character of a principle in physics. The growth of crystals of camphor and of iodide of cyanogen, by the deposition of solid matter upon them from an atmosphere unable to deposit like solid matter upon the surrounding glass, except at a lower temperature; and that of crystals in solution, by the deposition of solid matter upon them which is not deposited elsewhere in the solution, have been adduced by Mr. Faraday to illustrate the extension of the principle of action which is manifested in regelation; and "many such like cases," he remarks, "may be produced." In his reasoning on the

nature of that principle, he also rests on the fact, that ice has the same property as camphor, sulphur, phosphorus, metals, &c., which cause the deposition of solid particles upon them from the surrounding fluid, that would not have been so deposited without the presence of the previous solid portions.*

In reflecting on these indications of the universality of the cause, whatever it may intrinsically be, which is operative in the phenomena alluded to, it occurred to me that the known fact of the incorporation of two or more plates of glass into one block, presented a curious parallel to the incorporation of two or more slabs or separate portions of ice into one mass; and to determine in what manner these subjects were related to each other appeared to deserve careful investigation. Towards this the following suggestions are offered:—

Certain substances, both elementary and compound, appear to present, in what we term the solid state, phenomena corresponding to those which are presented by others in the liquid and solid states and the transitions from one to the other collectively regarded, and indicating the existence of a condition of matter which may be termed arrested liquidity, but yet is not, in the most perfect sense, solidity. Of these bodies glass is one. The fact in question, which exemplifies in a striking manner the property here alluded to, appears to have been first noticed as a subject of scientific importance by MM. Pouillet and Clement Desormes.† It is the incorporation, into one mass, of two or more plates of the kind of glass manufactured for mirrors, and called *plate-glass*, the polished surfaces of which have been placed, and have remained for some considerable time, at common temperatures, in close contact with each other, the entire area of one plate being in contact with the entire area of the contiguous one,—extensive mutual surfaces of contact being thus supplied. Under these circumstances, two, three, or four, or even a greater number of plates become converted into one block of glass, which it is impossible to separate into the original plates, and which may be worked, and even cut with a diamond, as if the whole had originally been a single mass. In some specimens which I have examined, with the surface of one plate were incorporated portions of another, the surfaces of fracture of

* Exp. Res. in Chemistry and Physics, pp. 380, 381.

† As far as my reading extends, it was first recorded by Pouillet in his 'Élémens de Physique,' liv. vi. ch. ii. 2me édit. Paris, 1832, tome iii. p. 41 (Bruxelles, 1836, p. 202). In the fourth edition, Paris, 1844, it appears to be omitted, together with other and established facts relating both to glass and to metals.

which were alone exposed, its substance having been torn through in the effort to separate the united plates by mechanical force.* The same effect took place in some experiments by Clement Desormes.

I assume it to be highly probable that the process by which the two plates of glass become one, is, in reality, analogous to that of regelation in ice, and finally dependent on the same principles, whatever their true character may be conceived or shall ultimately be determined to be. To this it may be objected, however, that there is no evidence, in the case of the glass, of the previous liquefaction, or even approach to liquefaction, of the surfaces which become united so as entirely to disappear (or, more properly speaking, to be altogether obliterated), and that the phenomenon is referable simply to the homogeneous attraction of the molecules of one plate for those of the contiguous one, the evenness of the two polished surfaces allowing them to be brought within a very minute distance of one another. But two remarkable facts greatly diminish the weight of this objection, if, indeed, they do not entirely remove it. First, unpolished plates of glass have no tendency to unite; the hard and compact siliceous film, to which Prof. Faraday, regarding glass "as a solution of different substances one in another," long ago referred its power of resisting agents generally,† and which previously bound together the outer molecules of each plate, must be removed by grinding and polishing, so as to render the actual surfaces of contact those of portions of the glass, the chemical nature and condition of which are such as readily to admit of their rapid mutual action and union into one mass. Secondly, the polished plates sometimes have the forms and configurations of the surfaces of straw and other packing-materials impressed upon them (portions of straw, paper, &c., sometimes adhering inseparably to the glass, after having been taken to hot climates),‡ in consequence of the soft nature of the substance exposed by the polishing, or of its nature being such as readily to soften by a temperature very much below that of the proper fusion, or even softening, of the glass in its integrity. The state of the interior portions of a plate of plate-glass appears, therefore, to be similar

* These and other facts of a similar nature I adduced as illustrative of the physical nature of glass, in lectures on that substance delivered before the Pharmaceutical Society of London in the year 1845. See Pharm. Journ. vol. v. (Oct. 1845) pp. 157-160.

† Phil. Trans. 1830; Exp. Res. in Chem. and Phys. p. 282.

‡ These particular facts were communicated to me by Mr. Tite, F.R.S., who had himself observed them.

to that of glass in general at certain temperatures much below its fusing-point, when it presents such remarkable characters of plasticity, tenacity, and ductility.*

Is it possible that a lowering of the melting-point of glass, or of the exposed interior portions of it, by pressure, is concerned in the union of the two plates? The effect of the mere pressure of the atmosphere, ensuing upon the exclusion of the air from between the closely apposed plates, would of course be insignificant in depressing the temperature of fusion of the glass; but the pressure occasioned by the cohesive force—exerted, it will be remembered, through a very small thickness only of the material,—which finally unites two or more plates into one block, would probably be adequate to any conceivable effect of this nature which can be required for the production of the phenomenon observed.

It may appear at first sight, that the fact that glass belongs to that class of bodies which contract on passing from the liquid to the solid state, and the melting-point of which, therefore, would be elevated—not depressed—by pressure, is opposed to this possibility. The objection would be a valid one were we now concerned with glass in a crystalline state. But we are treating of that substance in its familiar and ordinary condition, into which it passes from liquidity by a continuous gradation of temperature, through equally continuous states of softness into the solid form, like melted phosphorus and selenium.

I am now tempted to ask, in conclusion of this part of the subject, Are all cases of the union of two apparently solid surfaces of the same substance by cohesive attraction, cases of melting and regelation, an infinitesimally thin film of liquid being momentarily produced and as instantly solidified? Will two surfaces of perfectly dry ice, at temperatures much below 32°, but under favourable mechanical circumstances, unite by mere apposition and pressure (which ought to follow from Prof. James Thomson's theory), and thus prove the identity of the acting principle in the two cases of ice and plate-glass?

The negative of the last question does not appear to be proved by

* We are reminded by these facts of the view taken by Person, and adopted by Prof. Forbes, of the similarity of the liquefaction of ice to that of fatty bodies or of the metals, "all which in melting pass through intermediate stages of softness or viscosity;" and Sir J. F. W. Herschel (Art. "Meteorology," par. 119, Enc. Brit. eighth edit.), when he terms regelation "a sort of welding," appears to concur in this view.

the fact cited by Faraday and Tyndall, that dry, hard-frozen snow has not the property of becoming compacted into a snow-ball. The cases seem not to be comparable, because the brittleness of the constituent crystals of snow when in this state, its porous nature as a whole, and its being consequently pervaded by air, will prevent the required apposition of surfaces. Nor, as I conceive, is it proved by Prof. Tyndall's most instructive experiment of crushing a ball of ice, cooled by carbonic acid and ether, into white and opaque hard fragments; for in this also the required apposition of surfaces would be wanting. Further, it may be asked, whether this very experiment does not demonstrate the limitation of the lowering of the melting or freezing-point by pressure? and if so, there can be no tendency to union at 100° below freezing.

In discussing the philosophy of the union of two surfaces of glass, I have alluded to the theory of regelation enunciated by Prof. J. Thomson; but I wish to be understood as not adopting, exclusively, in these notes, any existing theory on the subject. Admitting the operation of cohesive attraction and consequent pressure in the first instance, the phenomenon, with respect to glass, readily admits of explanation by the original view of Mr. Faraday, which is, "that a film of water must possess the property of freezing when placed between two sets of icy particles, though it will not be affected by a single set of particles." If we regard the two apposed surfaces of glass, each consisting of a thin stratum of particles, taken together, as representing the film of water, then the other strata of particles in contact with them respectively, and making up the entire thickness of the plate on each side, will correspond to the two sets of icy particles, the action of which by freezing the film of water effects the union of the two portions of ice, and the phenomenon may be consistently explained in the terms of Mr. Faraday's theory. And here we seem to find points of coincidence between cohesive force, as ordinarily considered, the principle of regelation, and that particular view of the former which has been announced by Mr. Faraday in accounting for the phenomena presented by and connected with the latter.

2. But we are led by the preceding facts and considerations to some further inferences, if not indeed to a definite hypothesis, upon the subject of the molecular constitution or physical nature of glass. Mr. Faraday's view of it has been cited already; he regards glass,

it will be remembered, "as a solution of different substances one in another." Prof. Maskelyne has suggested to me, in conversation, that the physical nature of glass most probably nearly resembles that of a solution of a crystallizable salt in water, immediately before crystallizing. These views are evidently coherent, and they harmonize with Prof. Graham's, who defines glass, chemically, as "a mixture of silicates."* But they all relate to the varieties of glass in common use, while we are concerned, at present, with the abstract vitreous condition of matter, such as it is represented by the phosphoric and boracic acids, probably by the heavy optical glass of Faraday, by the simplest glasses of felspar and peridote obtained by Charles Deville, by the glassy condition of silica, natural and artificial, and still more perfectly, perhaps, by the glassy form of sugar.

Bearing in mind then the homogeneous, or comparatively homogeneous, nature of these glasses, and considering the uniformity of texture which the acoustic as well as the optical characters of perfect glass in general evince, especially when contrasted with that of crystalline plates in the acoustic researches of Savart, and how strongly distinguished that texture is from a crystalline texture or structure,—a nearer analogy than that of a solution ready to crystallize, I think, will be found in the condition of water cooled below the freezing-point but still remaining liquid, until by a tremor, or the percussive contact of a solid body, or the mere contact of a crystal of ice, its temperature rises to 32° and it becomes ice. If so, glass will be a substance in which this state of arrested liquidity, or potential solidity, is permanent. And this inference will harmonize with known facts. Gregory Watt proved that heat is evolved when mineral glasses crystallize or become (permanently and truly) solid.† The preparation of sugar called barley-sugar is the vitreous condi-

* These views of Mr. Faraday, Mr. Maskelyne, and Mr. Graham, are confirmed by the experimental evidence of the structure of glass obtained by Leydolt, to whose researches Professor W. H. Millar of Cambridge had the kindness to direct me. By etching the surface of glass, he found it to have a porphyritic structure, consisting of crystals imbedded in an amorphous substance. But the peculiar characters of glass, especially its relations to sound and light, evince, as indicated in the sequel, that it is not a congeries of ready-formed crystals, though in all probability crystals will always be found on its surface. The amorphous substance recognized by Leydolt will answer, nearly, to what I shall call "simple glass." Other facts which he observed are perfectly in harmony with our previous knowledge of the dependence of the texture of glass upon the rate of cooling. See Comptes Rendus, tome xxxiv. (1852, April 12) p. 565.

† Phil. Trans. 1804, pp. 285-290.

tion of that body, already taken as a type of simple glass; while granular sugar, and more perfectly sugar-candy, exhibit its crystalline state. Prof. Graham has shown that, at a certain temperature, by mechanical means the former may be converted into the latter, the temperature quickly rising 70° on the transition of the sugar from the glassy to the crystalline state. This and similar facts induced him to refer the peculiar constitution and properties of glass in general to the permanent retention of a certain quantity of heat in a latent state, which becomes sensible on its crystallization; and this will take place on its being preserved in a soft state at certain temperatures.

There are some remarkable and instructive parallels between the phenomena of the crystallization of water, and that of glass and some other bodies. It follows from the experiments and inductions of Gregory Watt already cited, that during the crystallization of glass a higher temperature must be communicated to the interior than that existing over its surface, by the evolution of heat at the points where the crystalline form is assumed, which will be gradually conducted throughout the mass. So that, in the express words of Faraday, in relation to ice, " by virtue of the solidifying [crystallizing] power at points of contact, the same mass may be freezing and thawing at the same moment;" and the "freezing process in the inside may be a thawing process on the outside," and thus contribute to the slowness of the cooling, and allow the crystallization therefore to be the more perfect. We here seem to have the explanation of the well-known fact, that in bodies which crystallize from a state of igneous fusion, the most perfect crystalline state is produced when the longest time intervenes between the commencement of solidification (now using that term in its ordinary sense) and the complete cooling of the melted mass. The cases cited from Mr. Faraday at the beginning of this paper, of the growth of crystals (including those of ice in ice-cold water) in solutions, all have their exact parallels in the accretion of crystals in cooling melted glass. " Crystals of ice," Mr. Faraday observes, " which could not be colder than the surrounding fluid, exhibited the phenomena of regelation." —that is, of incorporation into one—" when purposely brought in contact with each other." The same thing happens with melted glass slowly cooling, in which crystalline spherules, often forming spontaneously and independently, continue to form and to increase,

even after the glass has become solid as such, by the operation of a principle in this view analogous to regelation, until the entire mass has become crystalline.*

3. No crystalline body has been longer or more extensively subject to human observation, than crystallized water, or ice. Its natural history and properties, as science has advanced, have been investigated with increasing generality and precision; and they have finally become objects of that systematic and exact research which characterizes the present era of physical inquiry,—as is evinced by the discussion on regelation, to which these notes are intended to be supplementary. A most remarkable deficiency, however, still remains, apparently, in our knowledge of this substance:—*Water in the vitreous condition—Ice-glass—has never been observed.* While we know the antithetical vitreous state of so many different crystallized substances—minerals produced by heat, salts deposited from aqueous solution, neutral bodies of organic origin—and have great reason to believe that that antithetical condition to crystallization is universal, we have no knowledge of it in relation to water or ice. My own attention has been awake to the subject, without success, for many years. It would seem to be scarcely within the bounds of possibility that the glassy state of water, if possessing what we term solidity, should not, ere now, either have been observed in nature, or have occurred and been recognized in experimental research.†

* If we should prefer to adopt Mr. Maskelyne's suggestion in a formal manner, and regard glass as resembling a solution about to crystallize, its analogue, agreeably to the preceding views, will be a saturated solution of a salt in hot water, allowed to cool undisturbed, and remaining fluid, until its cohesion is affected, when its temperature rises, and the salt crystallizes. Specimens of glass are common which have the aspect and distribution of parts of a crystallized salt in the mother-liquor; opaque crystallized spherules appearing in the midst of a transparent mass. To these correspond, among natural glasses, pitchstone and many examples of porphyritic obsidian, consisting of a vitreous base in which crystals have been formed and are imbedded.

But at the same time the view I have taken of the subject, and Mr. Maskelyne's may be equally tenable; for the state of water remaining liquid at temperatures below 32°, and that of saline solutions remaining uncrystallized at temperatures below those of solidification, are evidently closely analogous.

Should I return to this subject, I shall refer to my friend Mr. Sorby's observations on the nature of glass, which I had not read when these notes were communicated to the Royal Society, but which are in entire agreement with the views I have suggested.—See Quart. Journ. of Geol. Soc. vol. xiv. p. 465.

† The crushed fragments of the ball of ice cooled in carbonic acid and ether, in Prof. Tyndall's experiment already mentioned, which "remained *white* and *opaque* as those of crushed glass," were still, he informs me, perfectly crystalline, resembling fragments of quartz.

The "points of analogy between the molecular structure of ice and glass" noticed by

I now venture to submit the inquiry, Does this apparent deficiency in our knowledge exist because—to use language recently introduced into physical science—the *homologue* of the glassy state of water is not what we ordinarily term solid—because the state of water cooled below 32° but still liquid is in fact the state which corresponds to the vitreous condition of other bodies, and to the physical nature of perfect ordinary glass? Is the one simply a case of potential solidity, and the other of the confluent or equivalent state of arrested liquidity?

It may be said that the homology which is here endeavoured to be established between liquid water below 32° and glass, is a forced one. That, in relation to each other, these are extreme cases is perfectly true; but intermediate terms of the series are not wanting, and some of them are supplied by sulphur and phosphorus, and in a remarkable manner by selenium. All these bodies, when melted, may be cooled many degrees below their freezing-points and yet remain fluid. Sulphur presents, in its viscid form, an approach to the glassy condition; but it may be obtained in the crystalline form on passing from a state of fusion, and when cooled below freezing, instantaneously crystallizes, like water, by mechanical disturbance.

In phosphorus also there is the viscid state; and when cooling after fusion, it passes gradually, like glass, from the liquid to the solid condition without crystallizing, though crystals are deposited from some of its solutions. Selenium presents a state resembling the viscid state of the preceding substances; but when melted, and left to cool remains fluid below its melting-point, and solidifies very gradually in its amorphous state (in which it has some of the characteristic properties of glass), and a thermometer immersed in it during the cooling does not remain stationary at any point, or indicate any temperature at which heat is evolved by molecular change in the substance, —as if the selenium passed continuously from the liquid glassy state to that of solid glass. At ordinary temperatures it retains this condition for a long time—as common glass does at higher, and as water and sulphur will at lower temperatures; but when heated again, between a certain temperature and its melting-point it becomes cry-

Mr. Drummond (Phil. Mag., August 1859, S. 4. vol. xviii. pp. 102—103) do not involve the physical condition of those bodies, but relate merely to the resemblance of one crystallized substance (ice) to another (Reaumur's porcelain), and of both to a third body (bottle- and window-glass), which, from its optical characters, is inferred—I thing inconsequentially—to have assumed a state preparatory to crystallization.

stalline and gives out great heat.* When glass is raised to a certain temperature, and by its maintenance is preserved in a soft state, it does the same.

In sulphur, phosphorus, and selenium, therefore, the fluid state below the temperature of solidification—the intermediate condition between fluidity and solidity—the viscid state long retained—the solid state of selenium which evolves heat on crystallizing—all appears to be homologues, at once, of liquid water below 32°, and of the glassy state of matter.

Should this hypothesis be verified, water below 32°, or rather, perhaps, from the temperature of maximum density downwards through that of freezing, may have to be regarded as the type of the vitreous condition of matter; and the causes of the peculiar characters of that condition, its effects on the transmission of the vibrations of sound and light, the conchoidal fracture, &c., may have to be discovered by researches on its molecular nature.

SCIENTIFIC AND LITERARY NOTES.

MINERALOGY AND GEOLOGY.

TABLES FOR CALCULATING THE THICKNESS, ETC., OF INCLINED STRATA.

In our last series of Notes (Vol. V., p. 544,) we gave a method of calculating approximately the thickness of inclined strata when the dip does not exceed five degrees.† The annexed Tables were drawn up to accompany the note in question, but were omitted from want of space. The angles of dip from 1° to 89° are contained in column *A*. The second column, *B*, shows the thickness in feet, corres-

* These properties of selenium are here stated on the authority of Hittorff, cited in Graham's "Elements of Chemistry," second edition, vol. ii. pp. 688, 689.

The case of vanadic acid strongly resembles that of selenium, but extends this series of concurrent phenomena to a range of temperatures nearly approaching those which govern the molecular changes of glass. It fuses at a red heat, and crystallizes on cooling, but remains fluid below its freezing-point. At the moment solidification commences, it again becomes red-hot, and remains so as long as crystallization continues.

The crystallization of glass, it has been seen, takes place at a high temperature, from the ordinary state of solidity, heat being evolved. So the glassy varieties of gadolinite (like glass, a silicate with a compound base), when its temperature is elevated above redness, remains solid, but evolves heat (becoming incandescent), and crystallizes: while the crystalline variety merely fuses and intumesces when similarly treated.

† The words "when the dip does not exceed 5°", were accidentally omitted in the note referred to. The reader is therefore requested to insert them after the word "strata" in the first line. (vol. v., page 544.)

ponding to the dip in column *A*, for each mile of distance. If, therefore, a set of strata, dipping at 23°, measure six miles across the strike, the thickness will be 12378 feet (= 2063 × 6). The third column, *C*, gives the thickness in parts of a foot for each foot of distance (or in parts of a yard for each yard, etc.); and the fourth column, *D*, shows the depth (in parts of a foot, yard, etc., for each foot, yard, or other unit of measurement), at which an inclined bed will be reached by vertical sinking at a given distance from its outcrop.† The figures in these two last columns are, of course, nothing more than the sines and tangents respectively of the corresponding degrees of dip in column *A*.

A.	B.	C.	D.	A.	B.	C.	D.	A.	B.	C.	D.
Dip in Degrees.	Thickness in feet per mile.	Thickness in parts of a foot per foot.	Depth from Surface. See above.	Dip in Degrees.	Thickness in feet per mile.	Thickness in parts of a foot per foot.	Depth from Surface. See above.	Dip in Degrees.	Thickness in feet per mile.	Thickness in parts of a foot per foot.	Depth from Surface. See above.
1°	92·15	·0174	·0174	31°	2719·4	·5150	·6008	61°	4618·0	8746	1·804
2	184·27	·0349	·0349	32	2798·0	·5299	·6248	62	4661·9	·8829	1·880
3	276·33	·0523	·0524	33	2875·7	·5446	·6494	63	4704·5	·8910	1·962
4	368·32	·0697	·0699	34	2952·5	·5591	·6745	64	4745·6	·8988	2·050
5	460·18	·0871	0874	35	3028·5	·5735	·7002	65	4785·3	·9063	2·144
6	551·91	·1045	·1051	36	3103·5	·5877	·7265	66	4823·5	·9135	2·246
7	643·47	·1218	·1227	37	3177·6	·6018	·7535	67	4860·3	·9205	2·355
8	734·83	·1391	·1405	38	3250·7	·6156	·7812	68	4895·5	·9271	2·475
9	825·98	·1564	·1583	39	3322·8	·6293	·8097	69	4929·3	·9335	2·605
10	916·86	·1736	·1763	40	3393·9	·6427	·8391	70	4961·6	·9396	2·747
11	1007·5	·1908	·1943	41	3464·0	·6560	·8692	71	4992·3	·9455	2·904
12	1097·8	·2079	·2125	42	3533·0	·6691	·9004	72	5021·6	·9510	3·077
13	1187·7	·2249	·2308	43	3600·9	·6820	·9325	73	5049·3	·9563	3·270
14	1277·3	·2419	·2493	44	3667 8	·6946	·9656	74	5075·5	·9612	3·487
15	1366·5	·2588	·2679	45	3733·5	·7071	1·000	75	5100·1	·9659	3·732
16	1455·3	·2756	·2867	46	3798·1	·7193	1·035	76	5123·2	·9703	4·011
17	1543·7	·2923	·3057	47	3861·5	·7313	1·072	77	5144·7	·9743	4·331
18	1631·6	·3090	·3249	48	3923·8	·7431	1·110	78	5164·6	·9781	4·704
19	1719·0	·3255	·3443	49	3984·9	·7547	1·150	79	5183·0	·9816	5·144
20	1805·9	·3420	·3639	50	3987·7	·7660	1·191	80	5199·8	·9848	5·671
21	1892·2	·3583	·3838	51	4103·3	·7771	1·235	81	5215·0	·9876	6·313
22	1977·9	·3746	·4040	52	4160·7	·7880	1·280	82	5228·6	·9902	7·115
23	2063·0	·3907	·4244	53	4216·8	·7986	1·327	83	5240·6	·9925	8·144
24	2147·6	·4067	·4452	54	4271·6	·8090	1·376	84	5251·1	·9945	9·514
25	2231·4	·4226	·4663	55	4325·1	·8191	1·428	85	5259·9	·9961	11·430
26	2314·6	·4383	·4877	56	4377·5	·8290	1·482	86	5267·1	·9975	14·300
27	2397·1	·4540	·5095	57	4428·2	·8386	1·539	87	5272·8	·9986	19·081
28	2478·8	·4694	·5317	58	4477·7	·8480	1·600	88	5276·8	·9993	28·636
29	2559·8	·4848	·5543	59	4525·8	8571	1·664	89	5279·2	·9998	57·290
30	2640·0	·5000	·5773	60	4572·6	·8660	1·732				

E. J. C.

MISCELLANEOUS.

NORTH-WEST TERRITORY.

In the last number of the Journal, (Vol. v. page 545 *et seq.*) we inserted an interesting article from the American Journal of Science and Arts, on the recent Canadian expeditions to the North-west Territory. A foot-note in this article, in reference to the late astronomer David Thompson, reads as follows:

"Thompson was from 1790, over 30 years in the employ of the Hudson's Bay

* This necessarily supposes the surface level to remain unchanged. If the one spot be lower or higher than the other, the difference must be deducted from, or added to, the depth obtained.

Company, and he reports of his explorations, (37 vols.) are deposited in the Archives of this Company. From fragments of them, it appears that Thompson possessed a great knowledge of the country, but it is doubtful whether these reports will ever be accessible to such as are not connected with the Company. Hitherto, the company has kept them back."

We now learn from ANDREW RUSSELL, ESQ., of Quebec, Assistant Commissioner of Crown Lands, that copies of Thompson's field-books of his explorations, are in the records of that Department. Mr. Russell has also obligingly furnished us with some extracts from Thompson's "Narrative" of his Expeditions. These will be published in an early number of the Journal. From some remarks prefixed by Mr. Russell to the extracts in question, it appears that Thompson was in the employment of the Hudson's Bay Company for thirteen years; and afterwards, for a period of fifteen years in that of the North-west company. He was, subsequently, for ten years, as Astronomer and Surveyor, on the Commission relative to the boundary between the British Possessions and the United States.

IRON-CASED FRIGATES.

The great experiment of iron-cased ships, now being carried on by the respective governments of Great Britain and France, will probably prove the inauguration of a new era in naval warfare. Few questions are attracting so large a share of public attention in those countries; and, so far as British interests are concerned, the subject is one, indeed, of paramount importance. Hence the accompanying article from an English journal, drawn up by one of practical acquaintance with the subject on which he writes, may not be thought an unworthy addition to our pages.

Another re-construction of the British navy is now imminent. It is not many months since it was announced in the Queen's Speech that the navy was to be re-constructed, and screw steamers have since that time superseded the old sailing three-deckers. No sooner has this great change been affected than we are again doomed to the mortification of hearing that all this additional expense has been thrown away; for in the words of the Secretary of the Admiralty, at the close of last session, "The French are building ten iron-cased ships, while we are only building four iron-cased frigates." We cannot permit the Emperor of the French, though he discourses at Marseilles so eloquently about "the olives of peace," to be ahead of us in this matter; for if ten iron-cased ships are necessary for the protection of France, which has a landed frontier for more than half of its extent, at least half as many more are necessary for the defence of our sea-girt island, putting altogether out of question any consideration of our colonies. Iron-clad ships are therefore a necessity. Economists may protest against the great expense which they will involve, and poets may sigh over the abandonment of our "wooden walls," and sailors may no longer sing, "The hollow oak our palace is;" but, if "our heritage" is to be the sea, ships in armour must be its guardians. Massive Goliaths, defiant in their strength and conscious of their comparative invulnerability, must form part of our Channel fleets for the present, and in a short time be the only sentinels to guard our coast. Three of these mail-clad vessels now float upon French waters, and, like the champion of the Philistines,

are said to laugh to scorn the sling and the stone of our unprotected three-deckers and frigates. *La Gloire*, *Pallas*, and *La Normandie* are already "great facts" on the other side of the Channel; the *Magenta* and the *Solferino* are on the stocks at Brest and L'Orient; the *Jennapes* is in process of conversion, and five others are far advanced. *La Gloire* has, it is said, succeeded admirably. She made 13½ knots upon her trial trip, is said to be very steady, and the experiment is pronounced in every respect satisfactory. She can carry seven days' coal, 500 rounds per gun, and her portholes are six feet clear of the water in an ordinary seaway. The *Normandie* will soon be ready for launching and steaming from Cherbourg, and the *Pallas* is being fitted out with great activity. The *Jennapes*, like the *Gloire* and her sister ships, is merely an old hull covered with iron plates, but instead of having the plates wall sided, like our floating batteries, and which can be pierced by the balls from the Armstrong or Paixhan heavy guns, she will have her sides built on a curve, and fluted at intervals, so that the shot will rarely strike on a flat surface. Of the *Magenta* and *Solferino* all that is permitted to be known of them is, that below water their hull is similar to that of ships on the old model, and their scantling is that of our 80-gun ships. The novelty consists in the form of the cutwater, which forms a straight line up to the surface of the water, forming an acute angle with the keel; it then recedes with a backward curve, and joins the bows, to which it is firmly attached by stout iron-cased timbers. The angular extremity of the cutwater, which is about fifteen feet from the bows, is of oak, and is to be fitted with a large conical spur in wrought iron. Of these vessels a French journal states that "Two of them placed on the coast of Ceuta would completely paralyse the guns of Gibraltar, and would be masters of the pillars of Hercules." This may be taken not merely as an opinion of the formidable qualities of these ships, but of the purposes to which they may probably be applied.

To meet this new description of vessels we have, at the present moment, four iron clad ships in hand, and a fifth, which is about to be commenced at Chatham. We have six iron floating batteries, which were built during the Russian war, but the French have the same number, and some of these saw actual service at Kinburn, while ours have not had the same good fortune. They are the ugliest and clumsiest looking craft afloat, they are barely floating, certainly not sailing, batteries; their movements are of the slowest description, and in a rough sea they would founder, but they are practically invulnerable. They present but a small surface to the enemy, and are fitted with ordnance of the largest calibre. They would, no doubt, be serviceable in the Medway, where they are at present stationed, in the event of any hostile fleet attempting to steam up the Thames. The French have, it is true, got a little start of us, inasmuch as they have three iron-cased ships afloat, one of which has been equipped for sea. This advantage, however, is only a temporary one; for fortunately for this country, ships of this class, to be really efficient and permanent, required to be built entirely of iron, while the French vessels are really nothing more than old wooden hulls, with iron plates attached to them. *La Gloire* is but the old *Napoleon*, with her upper decks taken off, and her sides plated. The four ships which we have on hand are new throughout, iron built, and the frigates will be the fastest ships in the

navy. The *Warrior* and the *Black Prince* are now fast approaching completion; the former is being built at the works of the Thames Ship Building Company, the other at the Clyde, by Messrs. Napier and Company. The *Warrior* was commenced in the month of June, 1859. and it is expected that she will be ready for launching on the 15th of December, though it is not improbable it may be a few weeks latter.* The ship, as well as the sister one in course of construction by Messrs. Napier on the Clyde, is not intended, as many persons suppose, like the ancient galleys, with power increased a thousand-fold, to run down anything which floats on the water, and is rash enough to be an opponent. It was originally intended to have built these two vessels of such a form and strength as to have made them available as "rams." As originally designed the bows of the ship were drawn after the outline of the lower part of the neck and breast of a swan when swimming, so that the point which would strike an enemy's vessel would be the breast which was under the water-line. The bows in this case would have formed an obtuse angle, the point of which would have been almost level with the water, and receding back at a rather sharp slope. This arrangement was to have been concealed with the usual figure-head and forward gear, as it was thought the enemy might be deceived by its appearance, and imagine it was nothing more than an ordinary ship. This notion, however, was soon abandoned; a trick of this sort was considered hardly worthy of being resorted to, even if it could have been for a moment successful. It would not have been easy to have deceived any naval man, who had any amount of experience or common sense, by the mere ornament of a figure head, as to the real character of a ship of more than 6,000 tons, nearly 400 feet long, and carrying only a broadside of 18 guns on her main deck. This idea was therefore soon abandoned, and the *Warrior* will appear honestly and fearlessly as an iron clad frigate, or corvette, carrying 36 main deck and two pivot guns. She is throughout an iron steamship, of most unusual strength, however, formed of plates ⅞ of an inch in thickness. She has an even keel, and the plates at the bottom are 1¼ inch in thickness. Her length over all is 420 feet, about two thirds the length of the *Great Eastern*; her length between perpendiculars is 380 feet, extreme breadth 58 feet, extreme depth 42 feet. Her tonnage is 6,117 tons, and she will have screw engines of 1,250 horse-power, and these, with the boilers and armaments, will give a total weight of considerably more than 10,000 tons. The lines upon which this frigate have been built are exceedingly fine, both fore and aft, and there is no reason whatever for supposing that she will not make fourteen knots an hour. Assuming that the performance of the *Gloire* has been correctly reported, and that she really made 13¼ knots and not miles, the *Warrior* would still be a faster ship. One point of superiority of the *Warrior* over the French ship is that the portholes are nine feet above the water, those of the *Gloire* being only six feet, and in a rough sea could not be worked. This is a very important feature in favor of our frigates; added to this fact that the *Warrior* and *Black Prince*, and the two steam rams, are built entirely of iron. There will be no trouble in these ships with respect to unseasoned or unsound timber, and the effects of the shot will not tell upon them

* Recent English papers convey information of the actual launch of the *Warrior* on the 29th of that month.

so severely as in the case of the wooden-plated ships of the French. An examination recently made of the *Trusty*, one of our iron-plated floating batteries, upon which experiments were tried, has shown that her timbers have been very much injured by the great shaking she underwent from the concussion of the shot from the Armstrong guns. The *Sirius*, also, upon the sides of which some plates were fixed for the purpose of experiment, before finally deciding upon the form to be given to those of the *Warrior*, also affords unmistakeable evidence of the shock to her timbers. The plates fixed on to the *Sirius* were fired at with old 68-pound shot, and at a short range the plates stood the shock well, and many persons supposed that a ship cased with this would have been perfectly protected against the fire of the heaviest sea ordnance. A close inspection of the interior, however, has thoroughly dispelled any such notion. Where the shot penetrated and passed through the iron plate as well as the vessel's side, the injury done has been actually less than when the penetration was less complete. In those parts where the plates have successfully resisted the shot, the timbers behind are driven into lathwood, the bolts are drawn, and the massive timber knees of the vessel were snapped asunder by the shock on the plate. So complete has been the destruction of the timber-work, that the vessel could not be repaired except in a dock, and until thoroughly repaired, a ship so struck would leak like a sieve and rapidly sink. The outer covering being of iron, it is, of course, impossible to repair her from the outside, while it would be hopeless to attempt to patch up her shattered timbers inside. The hurry with which the old French ships have been covered with iron plates may, after all, illustrate the fable of the hare and the tortoise in the old proverb, "The race is not always to the swift."

The shell of the *Warrior* and of the *Black Prince* is built, as we have stated, entirely of wrought scrap iron. The keel, or portion to which the ribs are bolted, is formed of immense slabs of 3ft. 6in. deep, and are $1\frac{1}{4}$ inch thick. The ribs, which spring from this are wrought iron T-shaped beams, made in joints of 5ft. in length by 2ft. in depth. They are placed 3ft. 8in. apart, except for a distance of 10ft. on each side of the keel, where they are bolted at half this distance apart. The main and upper decks are of iron, covered with timber, and the orlop deck is of timber. The decks are supported by rolled wrought iron girders of enormous strength. Along the entire length of the vessel, from stem to stern, there are solid wrought iron beams placed at intervals of 5ft. inside the ribs, and these again are strengthened by cross girders. The bows and stern of the ship are divided into twenty-seven water-tight compartments, and are shut off from the engine room and fighting portion of the ship by wrought iron transverse bulkheads. As the armour is not intended to cover the whole of the ship, these compartments will afford increased security to the ship. They may be riddled with shot in every direction without affecting the safety of the ship, nay, even the bows and stern may be shot clean away and the centre would still remain a floating battery 210ft. in length, 27ft. in depth, and 58ft. wide. The rig of the *Warrior* will be that of an 80-gun ship, and she will be armed with Armstrong's heaviest guns. The armour of the frigate consists of plates of hammered iron four-and-a-half inches in thickness. One cause of the delay which has occurred

in the completion of the ship has been the experiments which have been made in order to decide upon the best form and material for the outer covering. The tests which were applied to the plates furnished by the builders of the *Warrior* were of the most trying character, as shown by the effects of the *Sirius*, already referred to. Some plates were fired at with 68-pounders, at 200 yards' range, and were literally cut in half by balls fired one after another, on a line drawn on the surface, each ball striking immediately below its predecessor. Upon some other plates the ball made a circular indentation upon the surface, nearly as deep as the plates, exactly of the form of the projectile, and as though a mould had been taken of it in some soft and yielding substance. It was only after repeated trials that it was decided that the plates should be of annealed scrap iron. The labour involved in building up these plates is enormous. In the first instance small scraps of iron are thrown into the fires, and when in a state of red heat, are subjected to severe hammering, under the steam hammer, until the whole is beaten and amalgamated into a solid mass of about half a ton weight. This lump is then placed on the top of a similar mass, the whole made red hot, and hammered and welded together. Repeated additions of this kind are made, until about five tons of metal are thus welded together in one huge shapeless body. This is then brought to a glowing white heat, placed under the huge hammer, the thundering blows of which gradually reduce it into shape. Again and again the enormous slab is put into the furnace and hammered into one piece of fifteen feet long, three wide, and 4½ inches thick. From ten to a dozen men are engaged in the work of moving these ponderous masses of iron, which are moved about apparently with the most perfect ease. Powerful cranes swing the molten mass from the furnaces to the hammer, a nicely adjusted balance is provided by a massive iron lever, one end of which is welded into and forms part of the metal, and this is provided with a dozen or more of horns or handles, by which the iron can be turned in any direction; for the plates are not only hammered on the broad surface, but at the sides, and at the top and bottom. The plates, after having been roughly formed into shape, are completely planed and squared. Planing machines of enormous size hug these plates in their resistless arm, and bear them slowly and silently under the sharp cutting edges of the tools, and thin shavings of the metal, which, as they are cut, coil up in long bright ringlets of iron, attest the tremendous power of these noiseless and all but omnipotent machines. When the edges and surfaces are made perfectly smooth as the finest work of the cabinet maker, the plates are placed on an end, gripped firmly by a mortising machine, and as they travel slowly backwards and forwards in the framework, against a small tongue of steel, a groove of about an inch in width and depth is formed, into which the corresponding projections formed on the side of another plate will fit with the most perfect accuracy, the plates being all made to dovetail on each of the four sides.

The cost at which this armour-clad ship will be built is not much more than would be the cost of an oak timber-built ship of the same tonnage. The price at which the contract was taken was £40 per ton, the cost of an ordinary 80-gun timber ship is £37 17s. 6d. per ton. Not only is the *Warrior* an iron-built ship from stem to stern, but she is covered with 18 inches of teak timber over nearly

12,000 square feet of surface, and it is upon this bed of timber, itself reposing upon the iron sides of the ship, that the armour plates are to be fixed. These outer plates will be secured by iron bolts thirty-seven inches in lingth, which pass through the 4½ inches of iron plates, 18 inches of teak, five-eighths of an inch of iron forming the shell proper of the ship; and, finally, about nine inches of timber, which forms the inside lining of various portions of the structure. To the cost of the hull is to be added that of the engines of 1,200 horse power; these, however, will cost no more than would the engines of an ordinary screw line-of-battle ship, viz., about £72,000, at the rate of £60 for each horse power. The cost of the engines and ship will be about £300,000. The ordnance and stores probably about the same as an 80-gun ship, as all the guns will be Armstrong's, of the heaviest calibre. If the *Warrior* accomplish what may fairly be expected of her, she will be the cheapest ship in the navy. The Thames Shipbuilding Company, by whom she is built, have now adapted their machinery to the work required, and a sister ship would no doubt be built in half the time which has been taken up in constructing the *Warrior*. It is stated that the Government have ordered an iron-plated ship to be commenced forthwith at Chatham, in the royal dockyard, and it would be curious to ascertain whether a ship of this class can be constructed more cheaply there than in a private yard. The Admiralty have appointed four inspectors, who narrowly watch the progress of the works, and examine every portion of the iron work and timber before it is put into the ship. Mr. Hardy, the superintendent of the works, and Mr. Ash, the company's chief draughtsman, have devoted great time and attention to the work, and the ship, when completed, will, without any doubt, serve to keep up the high reputation which the Thames works have already acquired. It is a matter of regret that a second ship of the same class is not now in progress in the same yard, as while the outer plates are being performed, portions of another ship might be proceeded with.

What may be the value in a naval engagement of ships of this class can only be really tested in action. This much, however, is clear, that ships like the *Warrior* can successfully resist those destructive shells, of which a gallant officer recently said, "For God's sake keep out the shells." That at least is something done so far as these ships are concerned. But ships of the *Warrior* class can still throw shells filled with molten iron, or with liquid fire, or charged with powder which may explode on concussion with the sides of a wooden ship, while at the same time they are practically invulnerable to the heaviest shot that can be delivered by their opponents. Whitworth's gun may punch a hole in the iron cuirass of these ships with its flat-headed shot, within a limited range, but unless followed by a succession of such shots, or pierced with shells, the mail-clad *Warrior* may reel for an instant beneath the blow, but will not be seriously affected. In the case of shot piercing the sides, there is a covered way provided all round the ship for men to pass and plug up the holes. If struck either in the fore part or stern, the water-tight compartments will still keep the ship in safety. At those immense long ranges of Mr. Whitworth's, of which we have heard so much, there would be great dificulty in hitting the ship at all, and if struck the shot would fall harmless upon her. The great speed of the *Warrior* will give

her immense advantages over any other ship afloat. She could steam away from a broadside, or bear down upon a slower ship and deliver a concentrated fire of the heaviest guns, and receive no harm in return. It is only when the *Warrior* and *Black Prince* meet with ships of equal speed, power, and armament, that we shall be able to ascertain what is the progress which science has made in the art of maritime warfare.

The British Government have decided upon building two more ships, similar in almost every respect to the *Warrior* and the *Black Prince*, and tenders for their construction have been invited from the Thames Iron Ship Building Company, Messrs. Napier and Co, of the Clyde, and some other large ship building firms.

THE RECENT EXPEDITIONS OF THE "BULLDOG" AND THE "FOX."

(Condensed from an article in the London Times).

The expeditions sent out during the late summer by the British Government and the promoters of the North Atlantic Telegraph, respectively, for the purpose of examining into the practicability of the proposed scheme for carrying a line of telegraph from Europe to America *via* Faroe, Iceland, and Greenland, have at length returned, having successfully accomplished their arduous mission. Although the season was severe, and in every respect the most unfavorable for the route that has occurred for nearly half a century, the difficulties encountered, were not such as could prevent or retard the successful establishment of the line. It will be remembered that Her Majesty's ship, *Bulldog*, under the command of Sir Leopold M'Clintock, left England for the purpose of examining the depths of the sea between the various stations on the proposed route. The depths from his careful examination have proved altogether more favourable for the laying of a cable than those on which the former American cable was successfully submerged, the water being 400 fathoms less in its deepest parts. The *Bulldog* left the north of Scotland on the 1st of July for the Faroe Islands, taking soundings about midway, where, according to the charts, the depth was 680 fathoms, but finding soundings readily in 254 fathoms with a favorable bottom—a depth in which the laying of almost any kind of cable would be a matter of certainty. The *Bulldog*, after visiting several places among the wild and beautiful islands of the Faroe group, sounded across to Ingolfs Hofde, in Iceland. In this section of the route no difficulties were experienced, the average depth being under 300 fathoms, and the bottom being mostly of a favorable character. Sir Leopold M'Clintock subsequently visited and examined Faxe Bay, on the north-west coast of Iceland, which, notwithstanding the popular belief to the contrary, is as free from ice and icebergs as the shores of the Isle of Wight. From Iceland to Greenland, across what is technically called the Greenland Sea, the soundings were, as had been expected, found by the *Bulldog* to be deeper than on the Iceland and Faroe section of the route, but still the greatest depth was nearly 900 fathoms less than the deepest portion of the direct route. It is a remarkable fact, as showing the erroneous impressions which have prevailed even among scientific men respecting this region, that no ice was found away from the shore where the charts of Manby and Scoresby represent the sea as impenetrably covered with it. The *Bulldog*

being a paddle-wheel steamer, unadapted to such navigation, did not pass through the drift ice so as to land on the east coast of Greenland, so long considered inaccessible to ships. She stood, however, along the coast, sounding occasionally, nearly as far as Prince Christian Sound, when a gale of wind compelled her to stand off shore.

From the time of this date, (July the 19th, to the 18th of August,) Sir Leopold M'Clintock was unable to proceed with his soundings in consequence of continued gales of wind, which drove out the drift ice from the bays and fiords, and prevented the *Bulldog*, on account of her paddles, from approaching the coast. After attempting to enter several of the more southern ports, Sir L. M'Clintock entered Godhaab, towing in with him the vessel containing the coal intended for his ship. The weather had been most stormy, no less than eight gales of wind having been experienced during the preceding fortnight. The quantity of loose drift ice on the coast was greater, according to the information of the Danish residents, than had been seen for many years. The *Bulldog*, after having surveyed the harbor, coasted southward to Cape Farewell, as far as the prevalence of drift ice would permit. From that point, at some distance from the land, a line of soundings was carried to Hamilton Inlet, on the coast of Labrador. The depths between the two points were very regular, the greatest being 2,082 fathoms, 400 fathoms less than the direct route across the Atlantic. The examination of Hamilton Inlet made by Sir Leopold was necessarily a hurried and imperfect one, but very little ice was seen on the Labrador coast. On the return voyage a second series of soundings were carried from Hamilton Inlet to South Greenland, where the *Bulldog* anchored, in Julianshaab, on the 29th September. The weather she had experienced during her voyage from Labrador was most severe; she encountered no less than five gales of wind in eight days. After a cursory examination of some of the deep fiords which run inland for a considerable distance—several of which are deemed admirably adapted for the reception of the cable—the *Bulldog* left Julianshaab, on her return to Iceland, on the 3rd of October, and suffered some injury to her paddle floats and cutwater from the floe ice, which prevailed at the entrance of the fiord in larger quantity than had been known for nearly 30 years.

The *Bulldog*, up to this time, had obtained no information whatever respecting the *Fox*, and many began to entertain serious apprehensions that she had been beset upon the east coast of Greenland. Though made at the most unfavorable season, the examinations were said to be most satisfactory. In the channel of the various fiords a most considerable depth of water is almost universally found. On the 8th of October the *Bulldog* again approached the coast of Greenland, close to the entrance of Prince Christian Sound, at the extreme south end of Greenland, and found so very little ice that Sir Leopold M'Clintock commenced taking a line of soundings in towards the fiord. His intention, however, was frustrated by the springing up of one of those terrific easterly hurricanes which occasionally sweep the coast of Greenland. For 50 hours the wind blew with such terrific violence that no canvas could withstand its force for one moment, and the *Bulldog* had to lie to under "bare poles," keeping the engines going, in case of falling in with ice. For three days the vessel gradually drifted southward

and clear of the land. After the abatement of the gale, the *Bulldog* continued her line of soundings back to Reikiavik, in Iceland, but was subject to almost continuous interruptions from gales of wind. But the few soundings which could be made were of the most satisfactory character, a depth of only 748 fathoms being found where it was expected to find 2,000. The return soundings of Sir F. L. M'Clintock were of a peculiarly interesting character, in a scientific point of view, inasmuch as they set at rest the long disputed question of the existence of animal life at great depths in the ocean. Several starfish were brought up from the depth of 1,260 fathoms. At Reikiavik, information was obtained respecting the *Fox*. She had left that port for Greenland at the end of August. The *Bulldog* left Reikiavik on the 28th of October, experiencing on her homeward voyage a constant succession of foul wind, with frequent very heavy gales, which retarded, and in some instances completely prevented her sounding operations. Sir Leopold M'Clintock carried his line of soundings into the Rockall-bank, and on the 9th November obtained bottom in 1,340 fathoms, about mid-channel between it and the Vidal-bank. The wind still continuing adverse, and the coal being nearly exhausted, Sir F. L. M'Clintock was obliged to put into the port of Killybegs, county of Donegal.

The expedition of the *Fox* was fitted out at the expense of the promoters of the undertaking, and was intended not only to co-operate with the *Bulldog* in the sounding and general survey of the seas which intersect the various stations on the route, but also to fix upon and examine the precise localities for the landing of the cables, as well as to explore and fix upon the overland route through Iceland and Greenland. The expedition was commanded by Captain Allen Young, who accompanied M'Clintock in the celebrated voyage of the *Fox* in search of the Franklin expedition. Her cruise, like that of the *Bulldog*, was in her main results entirely successful, though her operations were retarded, and in some measure prevented, by the almost unparalleled succession of gales which prevailed with but little intermission from the time of her departure till her return to England. The *Fox* sailed from Cowes Roads on the 20th of July last, and after calling in the Downs, on the following day proceeded through the North Sea with a fair wind and calm weather. On the morning of the 24th, when off Whitby, the moderate breeze changed to a hard gale from the north—of course, dead ahead,—and for the two succeeding days the *Fox* could do little but hold her own against the wind and sea, which ran very high the whole time. During the 27th the sea was calm, and the winds, though light, were fair, so that by the morning of the 28th Aberdeen was reached, and in the evening, the *Fox* finally took her departure for the Faroe Isles. On the 29th and 30th, the wind continued still to blow stiffly ahead, which so far retarded the progress of the ship that it was midday on the 21st before the wild and rocky islands of the Shetland group were passed. For the two succeeding days the weather was squally, but the wind was generally sufficiently favourable to allow the ship to lay her course, "close hauled" to the wind, so that about twilight (10 p.m.) on the 2nd of August the lofty precipitous cliffs of the Faroes were sighted, distant 45 miles. From daylight on the morning of the 3rd a line of soundings was carried from a distance of 20 or 30 miles out into Thorshaven, Stromoe Island, the capital of the Faroe group. The

depths were found to vary from 800 to 30 fathoms, with a generally shelly or muddy bottom, and in every respect most favourable for the reception of a telegraph cable. On the afternoon of the following day the *Fox* again got under way, steaming through Hestoe Fiord, a wild and romantic channel, inclosed between the high mountains of Stromoe Island and the lofty basaltic cliffs of the islands of Nailso, Hestoe, and Coultra, for Heldervig, on the north side of Stromoe. The wind increased to a gale during the afternoon, she again anchored for the night in the small harbour of Westmanshaven, near the end of the fiord. The weather continued stormy and wet during that night and next day, so that it was late in the afternoon of the 5th of August before the *Fox* could again get under way. After getting clear of the land and outside the fiord, a severe gale of wind again sprang up, with a heavy sea, both setting the ship dead towards the stupendous basaltic cliffs, some of which rose perpendicularly from the sea to a height of 2,000 feet. While beating the ship out of this unpleasant position, an accident occurred which might have caused the loss of several of the crew. While the men were reefing, the foretopsail yard snapped in the middle, leaving the men clinging to the pieces, which dashed violently against the mast with every roll of the ship, threatening momentarily to fling them off into the sea, from which it would have been impossible to rescue them. They were all, however, eventually rescued from their perilous position; but five of them were more or less injured. The wind shortly afterwards fell again light; but the sea continued to drift the ship into unpleasant proximity to the cliffs, and it was not without some difficulty that she succeeded in rounding the north point of Stromoe, and reaching Heldervig Fiord.

On the evening of the 6th of August, the party under Dr. Rae, who had left the ship at Thorshaven for the purpose of making an examination of the island of Stromoe, arrived, and on the afternoon of the 7th, the damages having been repaired, the *Fox* started for Iceland, taking a line of soundings from the mouth of the fiord to about 20 miles out to sea, the depth varying from about 30 to 200 fathoms, with a bottom generally of a nature favourable to submarine lines. On the morning of the 8th it again blew a strong gale of wind from the north-east, with a heavy sea, which obliged the ships to lay to until the following morning, when the wind again fell light, but, the swell being heavy, little distance could be made by aid of the steam. In the afternoon a sounding was obtained, somewhat to the southward of the proposed line of cable, in 624 fathoms. The 10th was another day of light variable winds, during which but little progress could be made. At midnight, though some considerable distance from land, soundings were obtained in 60 fathoms' water. At daylight on the morning of the 11th, the high and beautiful mountains of the east coast of Iceland were plainly visible above the clear horizon, but they were soon obscured by one of those dense fogs which so frequently prevail in the North Atlantic during the summer. The ship was consequently obliged to come to an anchor for the day, under the lofty headland of Oster Horn. At daylight on the morning of the 12th of August, the fog having again lifted, the *Fox* got under way for Beru Fiord, standing northward along the coast, here rising in one beautiful chain of lofty and rugged volcanic mountains, the dark and barren sides of which are occasionally relieved by snow-

covered peaks and streams of glacier ice. At noon the anchor was dropped on the wild, mountainous inlet of Beru Fiord, close to the factory station. The day was beautifully fine and clear—a most unusual circumstance on that coast. The five following days were occupied in sounding and surveying the fiord and the various inlets and bays, many of which were found to be most favourable for the reception of a cable.

On the afternoon of the 15th, the party under Dr. Rae's superintendence left for the purpose of exploring and laying down the route for the landline across the island, intending to join the ship again at Reikiavik. On the evening of the 17th, the soundings and survey being complete, the *Fox* left Beru Fiord with a fair wind, and on the morning of the 19th reached the Westmanna Islands, off the south coast of Iceland. Having communicated with the shore, the *Fox* stood on her way to Reikiavik, those on board just catching a glimpse of Hecla, which was partially covered with clouds, in the distance. Passing the rugged lava streams of Cape Reikianæs during the afternoon, the *Fox* arrived in Reikiavik on the evening of the 20th. During the succeeding ten days, every part of the neighbouring coast which seemed to afford a favourable landing-place for a cable, was examined and thoroughly sounded; and several places, in every respect eligible for the reception of the cable, were discovered. On the 29th, Dr. Rae and his party returned, having successfully accomplished the difficult journey across the island, a distance of nearly 450 miles, in fourteen days.

From this date to the 9th of September, heavy gales and unfavorable weather kept the ship from making much progress westward; but on the 10th and 11th of that month, the weather having moderated, the progress made toward the Greenland coast was considerable, and yet no ice, nor, indeed, any indications of its presence were encountered, though in the chart of Manby, the whole sea over which the *Fox* had been sailing for the previous three days is laid down as perpetually covered with an impassable barrier of it. At 6 p.m. on the 11th, when distant 180 miles from Cape Valloe, East Greenland, a sounding was obtained in 2,135 fathoms. At daylight on the morning of the 12th the first ice and the supposed inaccessible east coast of Greenland were sighted. The land, which then, probably, for the first time, was seen from a ship, was of a high, mountainous, and generally precipitous character. Being short of water, Captain Young made the ship fast to a large floe of ice, from portions of which the tanks were soon replenished. Having obtained soundings, bearings, and angles, the ship coasted southward along the land, the ice lying closely packed along the coast; and the ship in the afternoon, being closely surrounded with floe pieces, was kept away to the margin of the ice. At daylight on the following morning, the 13th of September, the weather being fine and clear, the *Fox* again stood through the ice toward the land to within three miles off the high mountainous island called by the natives Omenarsuk. Some closely packed, heavy ice lay along the coast, and there being no opening for the ship to get in, and no prospect of an off shore wind to disperse it, the vessel was kept along the end of the land southward, looking out for a harbor. Views of the land angles and bearings for fixing positions were obtained. The appearance of open water in some of the fiords led to the hope that the ship might reach the coast, but during the afternoon the wind

freshened from the S. S. W. As the weather was threatening, Captain Young was compelled to stand off the land to the south-eastward for the night. On the 14th the *Fox* was about 60 miles east of Prince Christian Sound, having been led off the land with the ice, which appeared to have accumulated in most unusual quantity round Cape Farewell. Soundings were obtained in 1,120 fathoms gravel and sand, and again on the following day, 75 miles north-west of Cape Farewell, in 1,280 fathoms.

On the following day, September 15th, a violent gale sprung up from the north and north-west, which blew almost without intermission to the 20th, during which, on several occasions, Captain Young had penetrated into the ice in order to ascertain if the coast was sufficiently clear to admit of surveying operations in the southern fiords being carried on. On the 20th the high land about Cape Farewell was made at daylight, about 40 miles distant, the late gales having blown the ice into a compact part filling up the intervening space. As the sun rose the tops of the lofty mountains could be plainly discerned to be surrounded by a dense vapour, which looked like the smoke of a volcano, but which subsequently proved to be the effects of a violent hurricane whirling the snowdrift from the lofty summits of the mountains. The wind at the time was blowing stiffly from the northward so the *Fox* was hove to till the afternoon, under the lee of the ice. On the morning of the 21st the ice was found to be considerably loosened by the gale, leaving open lanes of water between streams of ice. Through one of these openings the *Fox* beat against a strong northerly wind till the afternoon, when, the weather moderating and the main body of the ice being sufficiently open to sail through, the *Fox's* course was shaped direct for the Channel, leading between the islands to Julianshaab. Night, however, coming on, Captain Young made the ship fast to an iceberg. The night was beautifully calm and the sea as smooth as glass; there was no moon, but the few black clouds which occasionally flitted across the sky served by contrast, to render the light of the aurora doubly brilliant. For the first portion of the night the ship lay as quiet as if in a dock,—a most inexpressible relief to those on board, who for the previous three weeks had been buffeted about amid an almost continuous succession of gales. A sounding was taken, and, though not more than 36 miles from land, a depth of 1,550 fathoms was found. As the night wore on the quiet which all enjoyed was disturbed by a slight swell, which caused the floe pieces to grind together with an ominous noise. After midnight the sky became overcast, the ship was uneasy, and the watches were almost constantly employed in resetting the ice-anchors. The barometer, which had stood very high, began to fall rapidly; at 3 o'clock a.m. a sudden gust of wind tore away all the ice-anchors while some of the hands were employed in resetting them, and the ship rapidly drove away from the berg, leaving the men behind. The steam was immediately got up, and by its aid, and that of the fore and aft sails, the men were recovered from the ice; but by the time this was accomplished the full force of a south-east hurricane had burst upon the ship. The sky was covered with a uniform dark mass of scud, from which the rain drove in torrents, freezing as it fell upon the rigging and upon the deck until everything was crusted with ice. The staysail was set,

but immediately blown away, the storm staysail and trysail were bent, but the wind had increased to such violence that no canvass could withstand its force.

The position of the *Fox* was at this time most perilous. Hove to under bare poles, the force of the wind was yet so great that she drifted with fearful rapidity, surrounded in all directions by loose pieces of ice. The spray was torn from the top of the waves, filling the lower stratum of air with eddying clouds like snow-drift, which blew with blinding violence into the faces and eyes of those on deck. The ship was in an almost helpless condition; the clouds of spray hid the pieces of ice from view until the ship was upon them, while the intense roar of the wind drowned every other sound, the ship driving helplessly before the wind avoiding many pieces of ice, but striking others with a force which would have immediately proved destructive to any other ship less strongly constructed. At 12 noon the ship ran stem on to a piece of ice with such force that even the power of the wind was insufficient to disengage her; other pieces of ice were driven astern, and for a few minutes the lives of all on board did not seem worth 10 minutes' purchase. The fore trysail was loosened and immediately split, but the impetus given was sufficient to clear her, and she glided from between the pieces as they closed. Throughout the remainder of the day the wind continued to blow with increased violence and the barometer to fall, and the bulwark stanchions on the starboard side were carried away by the sea and ice. The water in the engine-room increased so fast that at six p.m., it extinguished the fires, and the engines stopped, thus removing the last chance of steering the ship clear of the floe, pieces and bergs as they appeared. Night was also coming on, so that the preservation of the ship and those on board seemed little less than miraculous, as human exertions could do no more. At half-past seven p.m., the barometer, which had fallen an inch and a-half, showed a decided tendency upwards, and in half-an-hour the violence of the squalls was perceptibly less; from this time till 11 30 p.m., the wind continued to fall off until it so far abated that the ship could be hove to with the staysail set. At daylight on the 23rd sail was made, and the ship stood to the north-east with a fair wind. But so totally had the ship been driven out of her reckoning by the prevailing storm that she was found at noon to be nearly a degree to the northward of her supposed position, and according to the charts and chronometers, absolutely sailing upon the land; the former were, however, found ultimately to be incorrect. Very little ice was to be seen, the storm having, as is usually the case, effectually scattered and destroyed it. On the afternoon of the 23rd it again threatened, and in the evening agniu blew with such violence that the ship was hove to under storm staysail. During the succeeding eight days the *Fox* encountered nothing but a succession of foul winds and such heavy gales that it was impossible to reach Fredrickshaab for the purpose of refilling and obtaining water.

On the 2nd of October, after great difficulty, the above harbour was reached. Soon after her arrival, the ice from the southward again made its appearance, and as the reports concerning its extent were contradictory, a boat expedition was organized to examine it, and, if necessary to proceed to Julianshaab, about which district the principal examination would be necessary. After proceeding southward one day's journey, the ice was seen close in shore, but the sea far out was

apparently free. On the 12th of October the boats returned to the ships, and next day the vessel proceeded, with a strong northerly gale, through the Torsukalak Channel to Julianshaab, where she arrived on the 22nd of October. Having completed a survey of the port and the adjacent fiord, the Fox proceeded to the examination of a deep and romantic fiord called Tgalika Fiord, into which large icebergs never enter, and in the channel of which sufficient water was found effectually to prevent the grounding of the largest ever seen. Captain Young, after returning to Julianshaab, sounded the estuary of the fiord out to sea, and found that a uniform channel, 160 fathoms deep, could be depended on—a depth, it is needless to mention, considerably greater than that of any iceberg ever seen upon the coast. The winter had now fairly set in, and for weeks past quantities of ice had formed upon the surface of the bays and fiords, continually breaking up before it attained any considerable thickness; so Captain Young determined to return to England at the earliest apportunity, the season being over for proceeding with the examinations of either the Greenland coast or that of Labrador. But, at the beginning of November, the fiord through which Dr. Rae's party would have to pass on their return to the ship from their inland examination, was found to be frozen 16 miles from the head, and it was not without considerable difficulty that a sledge party reached them on the 6th of November, and informed them that a boat awaited their arrival at the open water. On the 8th of November the *Fox* sailed from Julianshaab, and after a rapid run of 15 days she entered Portland Roads. The results of the cruise are universally considered by those who accompanied the expedition to be most satisfactory. Colonel Shaffner's statements as to the existence of long deep fiords, in which the water was so deep as to preclude the remotest possibility of a cable being injured by ice or icebergs is fully confirmed. The existence of drift ice along the south coast is in reality no difficulty; it only prevails at the commencement of the season, unless in an exceptional year such as that recently experienced. Even when thickest its movements with various winds are so perfectly understood, that, under the command of experienced captains, many frail ships, totally unadapted to ice navigation, annually visit and return from all parts of the coast in safety. With regard to the American terminus of the line, now that the Greenland difficulty has been removed, when once the line has been carried to the latter in the 50th par. of western longitude, the landing on the opposite shore can be selected on any point within some hundreds of miles without materially increasing the length of the circuit.

IRON TRADE OF MARQUETTE: LAKE SUPERIOR.

We extract from a Marquette Journal, the following notice of the rise and progress of the iron trade of that district. On witnessing the activity displayed at the Marquette mines, during a visit to Lake Superior last summer, we could not help regretting most acutely that our Canadian ores of Marmora and the adjacent townships should be lying idle, purely for want of a railway or teamway to the front. The distance of Marmora from the Lake shore, is not greater than that between Marquette and the ore-beds of that region; and there are no engineering difficulties to render the construction a costly one. In matters of this kind, our enterprising neighbours leave us certainly far behind.

Much obscurity rests upon the early history of the Marquette iron trade. Previous to 1857, scarcely a trace of it can be found. And, indeed, previous to that year, there was but little of system in it, operations were desultory, and results small. But, from that time, the business has been systematized, and prosecuted with vigor from year to year, until it has grown to its present proportions. The following table will exhibit the increase of product from the epoch above mentioned, down to the present time:—

	TONS.		TONS.
Product of iron ore in 1857....	27,000	Product of iron ore in 1860 ...	150,000
" " 1858....	30,327		
" " 1859....	80,000	Total in the four years...	287,327

And next year's increase will be fully equal to that of the last.

	TONS.		TONS.
Product of pig iron in 1858....	2,000	Product of pig iron in 1860.....	5,000
" " 1859....	6,000		
		Total in three years....	13,000

CASTINGS.

Our two foundries have been in operation a little over two years, and their product is as follows, or very near it:—Product of Marquette foundry, 2,000 tons; product of Lake Superior foundry, 1,500 tons. Total, 3,500 tons.

There were also 300 tons of blooms shipped in 1857, and how much previously we do not know. That branch of the manufacture, however, has been abandoned.

It will be seen that the product of pig iron has fallen off the last year. That has been owing to temporary causes, considerable time having been taken up in repairs, and in introducing improvements with a view to increased product in future years. The prospect now is, that next year's product will reach 10,000 tons, if not a higher figure. But two stacks have been in blast at all the past year, except the three or four weeks' run of the new furnace at the Chocolate, whereas next year there will be four at least in blast, and five, if both stacks of the Pioneer Company are fired up; and the new impulse given to the iron trade will be likely to bring all the available facilities of production into requisition.

The blast furnace at Wyandotte last year, with only eight feet *bosh*, turned out thirty-five hundred tons of pig. At the same ratio of production, our five furnaces, should they all be in operation, ought to turn out fifteen to twenty thousand tons, worth, say $400,000.

The aggregate amount of ore brought down by the Marquette and Bay de Noc Railroad the present season for the different iron companies, is as follows, viz.:—

	TONS.
Jackson Company..................................	62,980
Cleveland Company..................................	47,889
Lake Superior Company..................................	39,395
Total.....................	159,263
Pig iron for Pioneer Iron Company..............................	3,050
" for S. R. Gay..................................	933
" for S. R. Gay by teams..................................	876
Northern Iron Company..................................	150
Total.....................	5,000

CANADIAN INSTITUTE.

SESSION—1860–61.

FIRST ORDINARY MEETING—*1st December*, 1860.

Professor DANIEL WILSON, LL.D., President, in the Chair.

I. W. H. Ellis, Esq., Civil Engineer, elected provisionally by the Council during the recess, was balloted for, and declared duly elected:—

II. *Donations received since the last meeting of the Institute, were anounced. (See Annual Report.)*

III. *The following paper was read:*

By the Rev. Professor W. Hincks, F.L.S.

"Remarks, Historical, Critical, and Explanatory, on the structure and arrangement of Ferns."

SECOND ORDINARY MEETING—*8th December*, 1860.

Professor DANIEL WILSON, LL.D., President, in the Chair.

The following Gentlemen were elected Members.

RICHARD BULL, Esq., Hamilton, C. W.

WILLIAM KINGSFORD, Esq., Toronto.

DOCTOR WOODS, (Army Medical Staff,) Toronto.

THOMAS BURNS, Esq., (Junior Member,) Toronto.

II. Professor Hunt, of the Canadian Geological Survey, made an interesting verbal communication on the Laurentian System of Canada and Scotland.

The following paper was then read:

By Professor Daniel Wilson, LL.D.

"On some of the traces of Ancient Arts and Civilization in the Valley of the Ohio."

III. The requisite nominations for the election of office-bearers for the ensuing year, were made; and the President announced the annual general meeting to be held on the 15th instant, to receive the Report of the Council, to elect office-bearers and members of Council for the ensuing year, and for other business.

ANNUAL GENERAL MEETING—*15th December*, 1860.

Professor DANIEL WILSON, LL.D., President, in the Chair.

The following Gentleman was elected a Member:

DOCTOR AGNEW, Toronto.

II. *The following donations for the Library and Museum were announced, and thanks of the Institute voted to the donors:*

FOR THE LIBRARY.

From Thomas Devine, Esq., Crown Lands Department, Quebec, (By the Hon G. W. Allan, M.L.C.)

Government Map of Canada, from the Red River to the Gulf of St. Lawrence, mounted and bound, 1859.

From T. C. Wallbridge, Esq., Toronto.

Sedgwick and Murchison, on the distribution of older or Palaeozoic Deposits of the North of Germany and Belgium, and their comparison with formations of the same age in the British Isles.

FOR THE MUSEUM.

From J. F. Smith, Junior, Esq., Toronto.

Sixty specimens of fossils from the Upper Green Sand of Dorset, England.

III. A ballot having been taken for Officers of the Institute, for the ensuing year, the following gentlemen were declared duly elected, viz:

President	Prof. D. Wilson, LL.D.
1st Vice President..........	Rev. Prof. W. Hincks, F.L.S.
2nd "	James Bovell, Esq., M.D.
3rd "	Rev. Prof. G. C. Irving, M.A.
Treasurer..................	D. Crawford, Esq.
Recording Secretary.........	P. Freeland, Esq.
Corresponding Secretary.....	Rev. Prof. E. Hatch, M.A.
Librarian..................	Prof. H. Y. Hind, M.A.
Curator....................	J. F. Smith, Junior, Esq.
Council....................	Hon. G. W. Allan, M.L.C.
"	Prof. J. B. Cherriman, M.A.
"	Prof. H. Croft, D.C.L.
"	T. C. Keefer, Esq., C.E.
"	Sandford Fleming, Esq., C. E.
"	Prof. E. J. Chapman.

IV. The report of the Council for the year 1859-60, was read and adopted on motion of Rev. Professor Hatch, seconded by G. Evans, M. A.

V. *The following Paper was read:*

By Professor E. J. Chapman.

"On some new facts regarding Stelliform Crystals, with special reference to the crystalization of snow.

ERRATUM.

Canadian Journal, No. XXX. (Vol. V. page 544). In "Simple Rules for Calculating the Thickness of Inclined Strata," add—after the word *strata* in the first line—"when the dip does not exceed 5°."

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—OCTOBER, 1860.

Latitude—43 deg. 39.4 min. North. Longitude—5 h. 17 min. 33 sec. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°. 6 A.M.	2 P.M.	10 P.M.	MEAN.	Temp. of the Air. 6 A.M.	2 P.M.	10 P.M.	ME'N	Excess of mean above Average	Tens. of Vapour. 6 A.M.	2 P.M.	10 P.M.	M'N
					°	°	°	°	°				
1	29.738	29.603	29.698	29.6722	43.9	49.3	48.6	47.20	— 3.22	.273	.323	.302	.301
2	.726	.724	.826	.7663	46.4	52.9	50.0	50.25	+ 0.32	.278	.274	.345	.307
3	.900	.882	.796	.8460	50.8	57.3	51.8	53.93	+ 4.40	.319	.290	.332	.320
4	.669	.650	.694	.6705	51.8	57.6	54.4	54.60	+ 5.57	.375	.410	.362	.380
5	.700	.669	.772	.7222	52.2	62.3	44.6	52.97	+ 4.35	.369	.324	.226	.306
6	.912	.868	.833	.8697	32.7	44.3	35.6	37.77	—10.45	.156	.194	.186	.176
7	.692	.392	—	—	35.6	47.3	—	—	—	.177	.220	—	—
8	.097	.224	.378	.2347	52.6	49.0	42.1	46.68	— 0.77	.322	.198	.204	.227
9	.293	.264	.337	.3010	39.2	47.9	42.1	42.97	— 4.10	.199	.240	.241	.224
10	.292	.115	.059	.1445	41.7	58.7	53.3	51.80	+ 5.02	.228	.351	.333	.303
11	.158	.419	.655	.4302	48.6	45.7	33.4	42.27	— 3.98	.231	.174	.140	.178
12	.685	.682	.748	.7110	28.4	44.1	36.3	37.45	— 8.52	.134	.178	.157	.158
13	.784	.813	.854	.8212	31.3	45.7	41.4	39.33	— 6.23	.151	.202	.187	.176
14	.922	.930	—	—	39.2	46.4	—	—	—	.216	.212	—	—
15	.818	.751	.715	.7575	38.1	47.9	37.4	41.57	— 3.28	.187	.230	.179	.198
16	.659	.531	.577	.5862	36.7	54.9	51.1	47.98	+ 3.45	.188	.286	.347	.271
17	.742	.844	.946	.8575	41.0	48.2	40.3	43.42	— 0.82	.246	.216	.158	.199
18	.962	.952	.938	.9610	39.6	45.7	46.1	44.20	+ 0.17	.210	.183	.273	.229
19	.953	.900	.829	.8908	43.5	51.1	45.0	47.08	+ 3.30	.250	.278	.249	.261
20	.792	.785	.807	.7978	46.4	52.2	46.1	47.50	+ 3.93	.212	.222	.294	.246
21	.657	.549	—	—	46.4	49.3	—	—	—	.308	.345	—	—
22	.595	.605	.613	.6153	48.2	50.8	49.3	49.20	+ 6.23	.328	.346	.344	.339
23	.557	.462	.435	.4895	48.6	51.1	49.3	49.18	+ 6.43	.342	.342	.332	.335
24	.505	.511	.334	.5405	43.4	54.7	46.4	48.45	+ 5.95	.269	.343	.275	.300
25	.592	.472	.523	.5300	41.7	55.1	49.0	48.65	+ 6.37	.234	.331	.287	.294
26	.608	.718	.870	.7463	41.7	50.8	35.3	43.02	+ 1.03	.228	.243	.181	.223
27	.932	.928	.870	.9097	33.8	45.0	46.8	42.70	+ 0.92	.157	.229	.273	.233
28	.790	.665	—	—	46.4	54.0	—	—	—	.278	.324	—	—
29	.716	.802	.836	.7995	51.8	58.0	47.5	52.13	+10.87	.375	.394	.276	.341
30	.742	.753	.710	.7460	51.8	61.6	54.4	55.55	+14.60	.363	.456	.385	.393
31	.692	.683	.723	.7060	55.1	63.7	56.2	58.03	+17.28	.409	.440	.406	.415
M	29.6392	29.6522	29.6917	29.6711	43.74	52.06	45.70	47.25	+ 2.21	.262	.236	.269	.272

Day.	Humidity of Air. 6 A.M.	2 P.M.	10 P.M.	M'N	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Resultant Direction.	Velocity of Wind. 6 A.M.	2 P.M.	10 P.M.	Resul't.	ME'N	Rain in Inches.	Snow in Inches.
								°							
1	.95	.91	.88	.92	E b S	Calm.	NWb N	N 44 E	3.4	0.0	5.4	1.42	2.38	0.325	...
2	.88	.69	.96	.85	Calm.	Calm.	Calm.	N 27 W	0.0	0.0	0.0	1.11	1.11	..	...
3	.85	.61	.86	.77	N W b N	S b W	N E	S 84 E	0.5	4.0	5.4	2.19	4.88	0.040	...
4	.97	.86	.86	.89	E	S E b E	Calm	S 63 E	4.0	2.5	0.0	1.09	1.14	0.005	...
5	.94	.57	.77	.76	S E b E	N W b N	N W	N 29 W	0.5	12.5	6.0	8.42	9.08	..	...
6	.84	.67	.89	.78	N b E	S S W	S S W	N 78 W	1.8	7.5	2.6	0.87	4.20	...	...
7	.85	.66	—	—	N b E	N E b E	Calm.	N 81 E	0.6	1.0	0.0	1.31	2.78	0.115	...
8	.80	.55	.76	.70	N W	N W	W N W	N 46 W	16.0	32.0	16.0	17.87	18.13	...	...
9	.83	.71	.89	.80	W N W	W b S	Calm.	N 79 W	4.5	10.8	0.0	5.42	5.51	Inp.	...
10	.86	.71	.82	.77	S W b W	S S W	S W b S	S 39 W	0.6	14.0	6.5	10.02	11.28	...	...
11	.67	.56	.74	.65	W b N	N W	N W b W	N 59 W	16.8	19.2	5.2	11.07	11.38	...	...
12	.86	.61	.74	.71	W N W	W b S	W N W	N 86 W	4.6	16.7	9.0	7.01	7.27	Inp.	...
13	.86	.66	.72	.73	N W b W	S b E	N	N 39 W	0.5	8.2	6.8	1.57	5.37	...	Inp.
14	.90	.67	—	—	N	E b S	N b W	N 24 E	8.8	6.0	7.0	4.23	6.27	...	...
15	.81	.69	.80	.75	N N W	S b W	S W b W	S 82 W	11.0	8.0	5.0	4.75	6.38	...	...
16	.86	.65	.92	.79	W S W	S S W	N W b N	S 75 W	4.2	15.0	4.5	3.94	10.29	0.190	...
17	.96	.64	.63	.71	N b E	N b E	N	N 7 E	13.0	11.8	9.2	10.69	10.83	...	...
18	.87	.60	.87	.79	N	N N E	N	N 20 E	7.8	5.0	3.2	3.80	3.91	...	...
19	.89	.74	.83	.81	N	S	N b W	N 10 E	1.2	3.5	9.8	4.29	6.23	...	...
20	.67	.56	.94	.75	N N E	N E	N E	N 47 E	9.0	11.2	10.2	11.20	11.37	0.173	...
21	.98	.98	—	—	E b N	E N E	E b N	N 70 E	11.5	17.5	11.0	12.08	12.13	0.220	...
22	.97	.93	.98	.97	E b N	E	E N E	N 85 E	6.7	7.4	5.9	6.41	6.45	0.115	...
23	.100	.91	.94	.96	E	E b S	E b S	S 77 E	2.3	2.0	2.0	1.83	3.12	0.095	...
24	.96	.79	.86	.87	W b N	W b S	W N W	S 75 W	4.1	7.4	1.0	2.72	3.10	0.105	...
25	.100	.76	.82	.86	W N W	E b S	N W b W	N 70 W	3.3	8.0	3.4	1.98	5.33	...	..
26	.86	.65	.88	.80	W b N	N N W	N b W	N 41 W	7.0	9.2	1.5	6.90	7.28	...	..
27	.81	.83	.85	.83	N b W	E b N	E b N	N 74 E	4.8	12.4	14.0	11.10	11.66	...	..
28	.88	.78	—	—	E	E b N	S b W	S 69 E	5.9	15.6	6.2	5.45	9.21	0.225	..
29	.98	.82	.84	.87	S W	W b S	S W b W	S 84 W	8.5	6.8	2.4	3.78	6.12	...	..
30	.94	.84	.91	.89	E N E	E	S E	N 83 E	6.0	9.2	2.5	5.21	5.81	0.010	..
31	.94	.75	.90	.87	S E b E	S b W	S b W	N 33 W	4.5	3.6	5.2	0.63	4.84	Inp.	.
M	.88	.71	.85	.81	....	....	....	....	5.61	9.27	5.38	......	6.93	1.618	Inp

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR OCTOBER, 1860.

Highest Barometer .... 29.982 at 8 a. m., on 18th } Monthly range=
Lowest Barometer .... 29.019 at midn't on 10th } 0.963 inches

Self-registering Thermom.:
- Maximum Temperature .... 68°0 on p. m. of 31st } Monthly range=
- Minimum Temperature .... 28°2 on a. m. of 12th } 39°6
- Mean maximum Temperature .... 53°35 } Mean daily range=
- Mean minimum Temperature .... 41°85 } 12°03
- Greatest daily range .... 23°2 from a. m. to p. m. of 6th.
- Least daily range .... 5°4 from a. m. to p. m. of 22nd.

Warmest day......... 31st ... Mean Temperature......... 58.05 } Difference = 20°55.
Coldest day......... 12th ... Mean Temperature......... 37°45 }

Maximum } Solar .... 84°5 on p. m. of 6th } Monthly range=
Radiation. } Terrestrial .... 19°0 on a. m. of 12th } 65°5.

Aurora observed on 0 nights.
Possible to see Aurora on 10 nights; impossible on 21 nights.
Snowing on 1 day; depth inap.; duration of fall 0.2 hours.
Raining on 15 days; depth 1.613 inches; duration of fall 66.0 hours.
Mean of cloudiness = 0.70.
Most cloudy hour observed, 6 a. m., mean = 0.77; least cloudy hour observed, midn't, mean, = 0.61.

Sums of the components of the Atmospheric Current, expressed in miles.

North.	South.	East.	West.
2274.68	807.70	1595.50	1823.79

Resultant direction N. 9° W.; Resultant Velocity 2.00 miles per hour.
Mean velocity... .... 6.93 miles per hour.
Maximum velocity .... 32.4 miles, from 1 to 2 p. m. on 8th.
Most windy day .... 8th...... mean velocity 18.13 miles per hour. } Difference=
Least windy day .... 2nd...... Mean velocity 1.11 ditto. } 17.02 miles
Most windy hour... noon to 1 p. m .... Mean velocity 9.56 ditto. } Difference =
Least windy hour... 9 to 10 p. m. .... Mean velocity 5.34 ditto. } 4.22 miles.

2nd. Foggy from 4.30 p. m. to midnight. 5th. Foggy from 6.45 to 7.30 a. m.
6th. Indistinct solar halo at 5 p. m. 10th. Slight dew at 6 a. m.
13th. Particles of snow at 8 p. m., depth inappreciable, (first of the season.)
19th. Fog at 6 a. m. 22nd. Dense fog from 8 p. m. to midnight.
23rd. Dense fog nearly all day. 24th. Imperfect rainbow at 4.30 p.m.; fog at midn't.
25th. Dense fog till 10 a. m.; thunderstorm and vivid lightning from 9 to 10.45 p.m.
26th. Heavy dew at 6 a. m. 27th. Perfect lunar halo from 6.20 to 9 30 p. m.
31st. Imperfect lunar halo at 11 p. m.; this was the warmest 31st October during the last 21 years.

The Resultant Direction and Velocity of the Wind for the month of October from 1848 to 1860 inclusive, were respectively N 36° W, and 1.72 miles.

October, 1860.—The Mean Temperature of this month was 1°83 above the average. The depth of rain was 0.[illegible] inches below the average. The mean velocity of the wind was 1.08 miles per hour above the average; and the amount of cloudiness was 0.0[illegible] above the average.

The month was, therefore, comparatively warm, dry, windy and cloudy; it was also remarkable for the very dense fog which continued, with a few intervals, from the 22nd to 25th inclusive.

COMPARATIVE TABLE FOR OCTOBER.

Year.	Temperature. M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	Rain. No. of days.	Inch's.	Snow. No. of days.	Inch's.	Wind. Resultant Direction.	V'y.	Mean Force or Velocity.
	°	°	°	°	°							
1840	44.4	−1.0	68.5	23.9	44.6	13	1.960	3	...	...	...	....
1841	41.6	−3.8	58.3	20.3	38.0	6	1.360	2	...	...	...	0.41 lbs.
1842	45.1	−0.3	65.5	30.0	38.5	8	5.175	0	...	...	...	0.35
1843	41.8	−3.6	55.7	21.5	41.2	12	3.790	4	2.5	...	...	0.54
1844	43.3	−2.1	69.[illegible]	17.8	51.8	7	Inap.	4	12.0	...	...	0.43
1845	46.4	+1.0	62.7	20.0	42.7	11	1.760	1	Inap.	...	...	0.26
1846	44.6	−0.8	60.7	20.7	40.0	14	4.180	2	Inap.	...	...	0.44
1847	44.0	−1.4	65.0	20.3	44.7	13	4.390	2	Inap.	...	...	0.19
1848	46.3	+0.9	62.2	28.4	33.8	11	1.550	0	0.0	N 31° W	1.24	4.60 mls.
1849	45.3	−0.1	59.2	25.5	33.7	13	5.965	[illegible]	Inap.	N 12° W	1.27	4.76
1850	45.4	0.0	66.6	24.8	41.8	10	2.085	0	0.0	N 63° W	1.10	5.50
1851	47.4	+2.0	66.1	25.0	41.1	10	1.680	2	0.3	S 72° W	1.06	[illegible]
1852	48.0	+2.6	70.7	29.8	40.9	12	5.280	0	0.0	N 5° E	1.19	4.47
1853	44.4	−1.0	[illegible]	[illegible]	39.2	10	[illegible]	2	Inap.	S 85° W	1.74	4.77
1854	49.5	+4.1	74.2	[illegible]	[illegible]	15	[illegible]	3	Inap.	N 47° W	1.52	[illegible]
1855	45.4	0.0	[illegible]	[illegible]	36.3	15	[illegible]	5	0.8	N 82° W	4.[illegible]	9.83
1856	[illegible]	[illegible]	70.1	23.3	46.8	10	0.575	2	0.1	N 73° W	2.15	6.07
1857	45.4	0.0	63.5	27.7	35.8	10	1.040	2	0.2	N 19° W	2.93	6.24
1858	45.8	+4.4	70.3	34.2	42.1	17	1.797	1	Inap.	N 34° W	0.36	5.96
1859	43.0	−2.4	68.4	22.3	46.1	11	0.940	4	Inap.	N 68° W	5.04	8.12
1860	47.3	+1.9	63.7	28.4	35.3	15	1.618	1	Inap.	N 9° W	2.00	6.93
M	45.37	...	66.57	25.15	41.42	11.5	2.510	2.0	0.88	....	...	5.85 Ml.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—NOVEMBER, 1860.

Latitude—43 deg. 39.4 min. North. Longitude—5 h. 17 m. 33 s. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°. 6 A.M.	2 P.M.	10 P.M.	Mean.	Temp. of the Air. 6 A.M	2 P.M	10 PM	ME'N	Excess of mean above Average	Tens. of Vapour. 6 A.M	2 P.M.	10 P.M.	M'N
1	29.794	29.759	29.773	29.7772	53.3	62.3	60.5	58.88	+18.42	.366	.459	.484	.434
2	.786	.715	.675	.7220	57.2	59.4	56.2	57.37	+17.10	.404	.363	.360	.373
3	.564	.510	.393	.4817	52.6	52.2	47.9	51.02	+11.02	.386	.369	.311	.347
4	.385	.413	—	—	41.0	47.5	—	—	—	.192	.162	—	—
5	.327	.401	.506	.4245	42.8	45.0	37.4	40.87	+ 1.88	.152	.128	.179	.155
6	.520	.529	.654	.5775	32.0	42.8	34.2	36.33	— 2.83	.151	.186	.152	.158
7	.752	.790	.880	.8170	29.1	39.2	32.7	33.67	— 5.33	.146	.155	.135	.149
8	.906	.850	.820	.8545	31.3	38.9	33.1	34.30	— 4.38	.136	.159	.160	.152
9	.731	.573	.304	.5172	36.0	41.7	38.8	38.95	+ 0.55	.162	.218	.220	.203
10	.214	.217	.346	.2698	39.2	39.6	39.6	39.45	+ 1.37	.223	.219	.219	.219
11	.406	.390	—	—	39.2	43.5	—	—	—	.216	.240	—	—
12	.406	.428	.611	.4020	37.8	49.0	37.8	41.28	+ 3.78	.190	.217	.183	.191
13	.681	.724	.781	.7388	34.5	46.8	38.1	39.45	+ 2.27	.181	.216	.204	.199
14	.774	.821	.808	.8138	31.3	47.5	39.9	38.97	+ 2.07	.152	.255	.181	.190
15	.816	.806	.881	.8338	32.7	47.2	39.2	39.32	+ 2.82	.171	.239	.207	.204
16	.850	.810	.739	.7935	38.5	42.1	41.4	40.58	+ 4.38	.190	.204	.232	.213
17	.615	.420	.298	.4332	41.4	45.2	43.5	43.22	+ 7.42	.250	.280	.268	.264
18	.156	.038	—	—	39.6	[illegible]	—	—	—	.219	.164	—	—
19	28.844	28.909	.078	28.9568	40.7	42.1	36.3	39.33	+ 4.25	.224	.187	.134	.176
20	29.132	29.286	.456	29.3075	34.2	36.0	27.3	32.25	— 2.52	.152	.130	.133	.136
21	.491	.478	.578	.5225	25.5	34.9	31.3	30.45	— 3.95	.125	.139	.151	.140
22	.638	.600	.538	.5873	33.1	38.9	37.1	36.33	+ 2.25	.167	.168	.158	.166
23	.354	.268	.047	.2042	36.3	40.7	39.6	39.17	+ 5.50	.210	.204	.219	.213
24	.080	.083	.304	.1743	19.0	21.2	16.5	17.93	—15.33	.079	.092	.064	.074
25	.516	.699	—	—	15.8	19.4	—	—	—	.060	.043	—	—
26	.959	.753	.491	.7115	16.8	26.6	36.0	26.97	— 5.60	.073	.134	.196	.138
27	.376	.607	.790	.6107	39.9	34.2	29.5	33.87	+ 1.68	.233	.135	.106	.157
28	.760	.721	.625	.6947	25.1	33.8	28.8	28.82	— 3.07	.108	.122	.108	.113
29	.445	.232	.169	.2678	30.9	42.5	34.5	36.27	+ 4.77	.157	.182	.164	.162
30	28.989	28.896	.107	.0033	34.2	37.1	24.8	31.60	+ 0.52	.187	.192	.099	.153
M	29.5300	29.5072	29.5251	29.5226	35.59	41.80	37.00	37.95	+ 1.80	.192	.206	.193	.195

Day.	Humidity of Air. 6 A.M	2 P.M.	10 P.M.	M'N	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Resul't. Direction.	Velocity of Wind. 6 A.M.	2 P.M.	10 P.M.	Result'.	ME'N	Rain in inches.	Snow in inches.
1	.89	.82	.92	.87	N b W	N E	E	N 55 E	12.2	11.2	10.0	10.77	11.71	...	...
2	.86	.71	.80	.79	E N E	E b N	E N E	N 78 E	21.0	19.2	15.8	15.52	16.36	0.125	...
3	.97	.94	.93	.92	E b N	S E	E S E	S 7 E	14.2	8.0	2.8	3.71	8.43	0.412	...
4	.75	.48	—	—	W S W	S W	SW b W	S 56 W	5.0	22.0	12.5	15.05	15.35	0.050	Inp
5	.55	.42	.80	.61	S W	S W b W	W S W	S 67 W	15.5	15.0	9.8	9.02	9.10	...	...
6	.83	.67	.77	.73	W S W	W S W	W N W	N 81 W	3.2	10.2	9.0	7.81	8.45	..	...
7	.92	.64	.73	.78	W N W	W N W	W N W	N 63 W	6.5	7.0	4.0	7.66	8.04	...	...
8	.77	.67	.84	.77	N b W	E S E	E b S	N 40 E	5.2	3.5	5.2	3.28	4.35	...	...
9	.76	.82	.94	.85	N E	N E b E	N E b E	N 50 E	10.5	14.8	22.7	14.93	15.14	0.818	...
10	.94	.90	.87	.90	NE b N	N b W	NW b N	N 13 W	14.0	12.5	10.0	11.15	11.98	0.065	...
11	.90	.85	—	—	NW b N	N W b N	NW b N	N 30 W	11.8	12.0	3.0	9.07	9.17	...	...
12	.87	.61	.80	.74	N W b N	N W	N N W	N 33 W	1.5	15.0	4.0	10.37	10.48	...	...
13	.90	.67	.88	.82	N N W	NW b N	NW b N	N 29 W	11.6	10.0	4.5	7.36	7.45	...	...
14	.86	.77	.73	.78	NW b N	SW b W	W S W	N 72 W	7.5	6.4	3.8	3.14	4.16	...	...
15	.92	.74	.86	.85	NW b N	NW b N	NW b N	N 31 W	0.2	10.2	6.5	5.59	5.65	...	...
16	.81	.76	.89	.84	N b W	E N E	N E b E	N 36 E	5.0	1.8	2.0	1.91	2.19	...	...
17	.95	.93	.95	.94	N E b E	E N E	N b W	N 14 W	3.0	4.2	4.5	2.49	3.12	0.150	...
18	.90	.66	—	—	W N W	SW b W	S S W	S 43 W	3.5	12.0	22.0	12.61	13.37	0.055	...
19	.87	.69	.62	.71	S W b S	W S W	W b S	S 69 W	9.3	18.5	11.5	13.15	13.36	...	...
20	.77	.61	.89	.75	W b S	W N W	W	N 81 W	9.2	23.0	7.5	13.68	13.90	...	Inp.
21	.91	.68	.86	.83	W	W b S	W b N	S 89 W	6.2	10.0	10.0	8.72	8.88	...	Inp.
22	.88	.70	.71	.78	S W b W	S W	S b W	S 27 W	11.5	18.5	9.0	13.27	14.87	0.200	...
23	.98	.80	.90	.89	S S W	S W b S	S S W	S 58 W	15.6	19.0	8.5	14.45	15.31	0.132	Inp.
24	.76	[illegible]	.68	.74	W S W	W S W	W S W	S 67 W	27.7	25.0	23.0	27.40	27.45	...	Inp
25	.66	.39	—	—	W b S	W b S	W b S	S 74 W	31.5	21.5	12.0	18.38	18.40	...	...
26	.78	.93	.93	.88	W S W	E S E	S	S 12 E	7.2	12.7	15.4	9.01	11.50	0.180	1.5
27	.96	.69	.65	.78	S W	W b N	W b S	S 83 W	11.5	24.6	7.0	13.74	14.21	...	...
28	.80	.63	.68	.71	W S W	S W b S	SW b W	S 60 W	2.2	10.0	4.5	4.94	5.34	...	..
29	.90	.66	.82	.76	SW b W	S W b S	SW b W	S 46 W	1.5	13.5	2.6	7.36	7.47	0.290	Inp.
30	.94	.86	.73	.83	SW b W	N W	NW b N	N 34 W	4.2	12.8	23.3	15.18	15.39	0.092	0.4
M	.86	.74	.81	.80	...	...	...	...	9.63	13.54	9.55	.....	11.02	2.569	1.9

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR NOVEMBER, 1860.

Highest Barometer . . . . **29.959 at 6 a. m. on 26th.** } **Monthly** range=
Lowest Barometer . . . . **28.844 at 6 a. m. on 19th,** } 1.115 inches.

Self-registering Ther.
- Maximum temperature . . . . 64°5 on p.m. of 1st } Monthly range=
- Minimum temperature . . . . 13°2 on a.m. of 25th } 51°3
- Mean maximum temperature . . 43°23 } Mean daily range = 9°70.
- Mean minimum temperature . . 33°53 }
- Greatest daily range . . . . . . 23°0 from a. m. to p. m. of 26th.
- Least daily range . . . . 2.3 from a. m. to p. m. of 10th.

Warmest day . . 1st ... Mean Temperature . . . 58°88 } Difference=40°95.
Coldest day . . . 24th ... Mean Temperature . . . 17°93 }
Maximum { Solar . . . . 81°5 on p. m. of 1st } Monthly range=
Radiation { Terrestrial . . . . . . 7.5 on a. m. of 26th } 74°0.
Aurora observed on 1 night, viz.: on the 4th; possible to see Aurora on 12 nights; impossible on 18 nights.
Snowing on 8 days; depth, 1.9 inches; duration of fall, 20.9 hours.
Raining on 12 days; depth, 2.569 inches; duration of fall, 82.4 hours.
Mean of cloudiness=0.70; most cloudy hour observed, 4 p. m., mean=0.78; least cloudy hour observed, midnight; mean=0.63.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
2139.31	2210.83	1165.38	4743.40

Resultant direction, S 89° W; Resultant Velocity, 4.95 miles per hour.
Mean velocity 11.02 miles per hour.
Maximum velocity . . . 33.6 miles, from 6 to 7 a.m. on the 25th.
Most windy day . . 24th—Mean velocity, 27.45 miles per hour. } Difference 25.26
Least windy day . . 16th—Mean velocity, 2.19 do } miles.
Most windy hour, noon to 1 p. m.—Mean velocity, 14.07 miles per hour. } Difference
Least windy hour, 11 p m. to midnight—Mean velocity, 9.29 do. } 4.78 miles.

1st. Very mild day, being the warmest **1st November for 21 years.**
3rd. Very perfect rainbow from 1.50 to **4.30 p.m.**
4th. Brilliantly coloured aurora from **6 to 9 p.m.**
6th. Hoar frost and thin ice at **6 a. m.**
23rd. Rapid descent of temperature from
23rd, midnight = 39°.6
24th, 8 a. m, = 16.1
Range in 8 hours = 23.5
24th and 25th. Very cold, stormy days.
27th. Well-defined lunar halo, from 7 to 9 p. m.; lunar corona from 9.40 p. m.
28th. Very perfect lunar halo from 9 to 11.30 p.m.
29th. Imperfect lunar halo from 8 to 10 p.m.

The Resultant Direction and Velocity of the Wind, for the month of November, from 1848 to 1860 inclusive, were respectively N. 73° W., and 2.34 miles.

The mean temperature of November, 1860, was 1°23 above the average of 21 years, and the mean velocity of the wind 3.52 miles per hour in excess of the average of 13 years; the depth of rain and snow recorded, were both in defect of their respective means, the former by 0.513 and the latter by 1.19 inches.

The month was consequently warm, dry, and very windy.

COMPARATIVE TABLE FOR NOVEMBER.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	No. of days.	Inches.	No. of days.	Inches.	Resultant Direction.	Resultant Velocity.	Mean Velocity
	°	°	°	°	°					°		
1840	35.9	— 0.8	54.4	20.5	33.9	5	1.220	8	...	...	...	...
1841	35.0	— 1.7	63.2	7.6	55.6	8	2.450	5	...	...	...	0.91 lbs.
1842	33.3	— 3.4	50.6	7.6	43.0	9	5.310	10	...	...	...	1.22 "
1843	33.5	— 3.2	51.2	14.4	36.8	10	4.76[illegible]	7	1.2	...	...	0.59 "
1844	34.9	— 1.8	40.8	12.0	37.8	8	imp.	4	8.0	...	...	0.48 "
1845	36.8	+ 0.1	58.8	7.6	51.2	7	1.105	4	5.0	...	...	0.53 "
1846	41.3	+ 4.6	55.5	18.2	37.3	12	5.805	2	0.4	...	...	0.64 "
1847	38.6	+ 1.9	58.2	7.8	50.4	14	3.155	3	Inp.	...	...	0.36 "
1848	34.5	— 2.2	49.3	16.5	32.8	9	2.020	3	1.4	N 81 W	1.81	4.81 ms.
1849	42.6	+ 5.9	56.7	28.4	28.3	10	2.815	2	1.0	N 39 W	1.55	4.78 "
1850	38.8	+ 2.1	62.3	18.1	44.2	7	2.955	1	Inp.	N 42 W	1.43	5.27 "
1851	32.9	— 3.8	50.1	16.5	33.6	5	3.885	6	6.7	N 50 W	1.25	4.70 "
1852	36.0	— 0.7	50.4	18.7	31.7	7	1.775	3	2.0	N 59 W	1.53	6.50 "
1853	38.7	+ 2.0	54.1	14.4	39.7	15	2.425	6	2.7	N 9 W	0.55	5.52 "
1854	36.8	+ 0.1	54.9	15.1	39.8	13	1.115	4	1.3	W	3.44	7.54 "
1855	38.6	+ 1.9	54.1	18.7	35.4	8	4.590	6	3.0	N 66 W	3.18	10.81 "
1856	37.4	+ 0.7	56.4	22.8	33.6	10	1.375	9	9.5	S 85 W	2.05	8.75 "
1857	33.5	— 3.2	57.8	-2.3	60.1	14	3.235	9	6.9	S 61 W	5.45	9.25 "
1858	34.2	— 2.5	52.0	20.5	31.5	12	3.879	13	4.0	N 25 W	3.14	8.87 "
1859	38.9	+ 2.2	61.0	24.1	36.9	12	5.193	9	0.6	N 81 W	3.39	9.65 "
1860	37.9	+ 1.2	62.7	14.0	48.7	12	2.569	8	1.9	S 89 W	4.95	11.02 "
Mean	36.67	...	55.40	15.30	40.11	9.9	3.082	5.8	3.09	...	...	7.50

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—AUGUST, 1860.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.—F.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Horizontal Movement in Miles in 24 hours.	Mean of Ozone. (tenths)	Rain in Inches.	Snow in Inches.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.					6 A.M.	2 P.M.	10 P.M.
1	29.854	29.826	29.954	50.0	68.8	59.2	.258	.319	352	.71	.47	70	w	w s w	s w b s	166.90	2.5	...	...	Clear.	Clear.	Clear.
2	972	859	990	52.5	80.6	66.0	282	445	407	74	43	63	s w	s w	s w	4.80	1.0	...	...	Do.	Clumb. 2.	Cirr. 2.
3	907	783	851	56.0	88.2	77.0	315	530	639	71	40	69	E b s	s s E	w b s	80.20	1.0	...	...	Do. h'vy dew	Clear.	Cu. Str. 9.
4	717	741	705	73.0	85.6	70.2	725	603	523	88	49	72	s w b w	w b s	N w	113.40	2.0	0.487	...	Cu. Str. 8.	Cu. Str. 6.	Str. 2. AuBor.
5	809	811	900	68.0	83.5	67.8	393	597	489	59	53	75	N E	w	w b s	119.60	1.5	...	...	Clear.	Clear.	Clear. Au Bor.
6	904	809	785	64.3	93.2	72.4	464	710	559	77	46	72	s b w	s s w	s w	13.80	1.0	...	...	Do.	Do.	Cu. Str. 6.
7	705	583	604	70.3	90.2	75.2	551	699	745	75	54	86	s b E	w	N N w	41.70	0.5	...	...	Do.	Hazy.	Do. 9. d. th. v. l.
8	720	616	594	71.1	87.2	73.2	572	664	728	76	52	79	w b s	w	s b w	39.40	2.5	...	...	Do.	Clear.	Str. 2. Au. Br.
9	585	614	708	73.2	79.0	65.8	393	574	516	85	58	84	s s w	s s w	s b w	63.50	2.5	0.300	...	Do.	C. Str. 8. thu.	Clear. do.
10	699	608	701	64.2	92.2	68.0	464	556	437	77	57	63	s s w	s b w	w	32 60	2.0	...	...	Do.	Do. 2.	C. Str. 9. ligt.
11	851	907	957	54.1	83.2	54.5	335	558	355	80	50	80	N	N E b E	s b E	59.30	2.5	In'p.	...	Cu. Str. 10.	Clear.	Clear. Au. Br.
12	824	786	811	46.1	80.9	66.2	262	624	502	84	59	78	s E b E	s	s s w	60.70	1.0	...	...	Fog.	Do.	Do. do.
13	444	146	735	63.8	65.0	60.8	543	583	462	94	94	91	s b E	N E	w N w	59.40	4.0	0.929	...	Rain.	Rain.	Cu. St. 9.
14	914	911	925	53.6	66.9	56.7	376	463	420	88	71	94	w	s w	s w	36.50	2.5	0.011	...	Cu. Str. 8.	Cu. Str. 6.	Do. 9.
15	995	30.070	30.057	54.5	72.0	64.2	328	397	464	77	52	76	w b N	N b w	w b s	149.40	1.5	...	...	Do. 6.	Clear.	Clear.
16	30.018	29.880	29.960	50.1	78.6	63.9	250	443	503	71	46	86	w s w	s w	s s w	82.30	1.0	...	...	Clear h. dew.	Str. 2.	Cu. St. 2. Au. B.
17	29.867	740	711	61.4	85.0	67.3	466	507	489	85	43	75	w s w	w s w	s s w	116.90	1.0	...	...	Do.	Clear.	Clear.
18	751	571	719	62.9	70.6	63.7	517	651	536	91	88	92	w s w	s s w	w N w	55.10	3.0	0.900	...	Nimb. 9.	Rain.	C. Str. 4. Au. B.
19	814	794	880	61.7	79.7	68.4	466	612	443	85	62	65	E b N	s E	s E b E	134.39	2.0	...	...	Cu. Str. 8.	Cu. Str. 4.	Do. 6.
20	826	766	851	67.6	77.4	68.9	626	705	671	95	81	96	s s E	s s E	s s w	174.71	3.0	0.430	...	Rain.	Do. 9.	Clear.
21	799	857	861	67.3	83.0	67.0	598	565	591	92	57	89	s s w	s w	s	101.20	2.5	0.230	...	Cu. Str. 8.	Do. 2.	Do. Au. B.
22	857	834	918	62.3	83.7	67.2	523	514	571	94	45	50	s b w	s w	s s w	54.20	3.0	...	...	Do. 10.	Cumb. 2.	Do. Au. B.
23	856	803	824	65.6	86.2	72.2	362	511	566	87	41	74	s s w	N E b E	N N E	90.60	2.5	...	...	Clear h. dew.	Clear.	Rain.
24	874	711	735	84.2	68.8	66.1	576	642	604	92	92	94	s E b E	s b E	s b E	136.00	3.0	4.095	...	Rain. Dis. th.	Cu. Str. 10.	Cu. Str. 8.
25	606	484	526	65.0	77.6	62.1	618	678	498	1.00	73	91	s	s s E	w b s	72.80	4.0	0.500	...	Cu. 4.	Do. 8.	Do. 6. L ra.
26	534	606	711	62.3	75.8	63.0	530	590	422	97	68	75	w	N w	w	251.60	3.0	...	...	Cu. Str. 8.	Clear.	Clear.
27	682	621	646	52.2	75.6	57.3	361	476	407	94	59	87	s s E	w	s w	71.80	2.0	0.453	...	Clear.	Cu. Str. 8.	Cu. Str. 6.
28	634	666	692	53.9	61.4	57.3	396	583	378	96	71	81	s s w	s w	s w	199.50	1.5	0.181	...	Cu. Str. 4.	Slight Rain	Do. 4.
29	733	715	809	55.5	76.4	59.2	298	541	439	90	60	88	s w	s w	s w	181.50	1.5	In'p.	...	Do. 6.	Showers.	Clear.
30	755	568	459	54.4	78.9	65.0	390	564	420	94	61	68	s w	w b s	s w	157.30	1.5	...	...	Clear.	Clear.	Do.
31	468	480	514	56.1	72.1	60.2	391	600	456	87	78	88	s w	w N w	w b N	138.10	2.5	0.070	...	Cu. Str. 10.	Cu. Str. 4	Cirr. St. 2.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—SEPTEMBER, 1860.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M.D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.—F.			Tension of Vapour.			Humidity of Air.			Direction of Wind.			Horizontal Movement in Miles in 24 hours.	Mean of Ozone. t'nths	Rain in inches.	Snow in inches.	Weather, &c. A Cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.					6 A.M.	2 P.M.	10 P.M.
1	29.748	29.786	29.833	53.0	70.1	50.5	.380	.397	.283	.94	.52	.78	N N W	w b N	N W	41.10	2.0	...	...	Clear.	Clear.	Cu. Str. 2.
2	916	944	30.073	45.6	64.6	53.9	280	243	370	88	42	84	w b N	N W	w b s	0.00	2.0	...	...	Do	C. C. Str. 4.	Clear.
3	30 212	30.208	130	42.9	72.3	59.2	237	263	358	88	31	73	w N w	w b N	w s w	98.60	2.0	...	...	Slight frost.	Clear.	Do.
4	114	037	29.974	44.0	83 4	67.7	258	630	550	87	54	82	s s E	s W	s w	45.40	1.5	0.300	...	Clear.	Cir. St. 4.	Cu. Str. 8.
5	29.916	29.804	843	66.2	82.3	70.2	604	650	621	94	59	81	s E	w b s	w b s	128.10	3.5	...	...	Rain.	Clear.	Clear.
6	839	845	957	63.3	80.3	59.7	536	599	380	82	59	76	w b s	w s w	w b s	17.20	2.0	...	...	Cirr. Str. 4.	Do.	Do. Au. Bor.
7	918	812	752	63.5	81.4	69.9	369	585	829	90	56	75	s w	s w	s w	162.00	2.5	...	...	Clear.	Do.	C. C. St. 9.
8	935	941	947	51.3	58.0	44.2	368	336	224	96	72	79	N E b E	N b E	N b w	223.10	2.5	...	...	Cu. Str. 8.	Cu. Str. 9.	Clear.
9	998	960	993	48.5	62.6	48.0	285	370	251	85	66	74	N E b E	N b E	N w	123.40	1.0	...	...	Clear.	Do. 6.	Do. [Bor.
10	902	783	307	48.0	64.2	55.0	214	403	328	95	67	77	w b s	w b s	w b s	103.70	1.0	0.800	...	Slight frost.	Do. 8.	Cu. Str. 9. Au.
11	802	701	677	35.9	64.4	53.0	293	403	375	96	67	93	w s w	w s w	s E	62.00	2.5	2.466	...	Clear h'y dew	Do. 10.	Rain.
12	699	726	747	45.6	44.8	46.3	297	275	293	98	92	96	N E b E	N N E	N	227.10	3.5	...	...	Rain.	Rain.	Cu. Str. 9.
13	800	889	770	47.3	71.4	55.0	199	371	341	90	49	93	N b w	w b N	w b s	254.30	1.5	...	...	Clear.	Clear.	Clear.
14	30.094	30.099	30.100	37.1	71.7	62.0	298	397	485	92	52	86	w b s	w b s	w b s	104.20	2.0	...	...	Do.	Do.	Do.
15	107	017	29.970	47.4	81.9	66.7	273	617	496	85	58	77	w b s	w b s	s w	50.00	2.5	Inap.	...	Do.	Do.	Do. Au. Bor
16	29.970	29.916	876	42.0	70.1	65.1	492	516	549	79	70	89	s W	s s W	s w	1.00	2.0	0.300	...	C. Str. 6.	C. Str. 10.	C. Str. 10. [B
17	760	815	897	62.8	72.3	62.2	549	489	429	97	62	77	s s W	W	s W	166.20	1.5	...	...	Do. 8.	Do, 4.	Do. 9. Au.
18	949	946	962	67.0	80.1	65.0	291	638	420	89	62	68	s w	s s w	s E b E	27.80	2.0	Inap.	...	Fog.	Clear.	Clear.
19	860	853	871	42.0	73.0	63.8	368	614	556	95	68	92	s E b E	s E b E	s s E	6.60	2.0	0.640	...	Clear.	Cu. Str. 6.	Do. Au. Bor.
20	679	642	596	51.7	69.3	65.0	321	678	849	87	97	89	s s E	s s E	w	261.30	3.0	0.600	...	Cu. Str. 10.	Rain.	Cu. Str. 4.
21	498	566	790	52.3	63.9	48.3	334	422	326	86	75	70	w s w	w s w	s w	138.90	2.0	0.400	...	Do. 10.	C. Str. 6.	Clear.
22	854	725	863	42.0	61.4	54.6	251	413	390	96	77	93	s w	s E	w s w	118.11	4.5	...	...	Clear.	Do. 2.	Cu. Str. 9.
23	963	30.017	999	39.7	60.0	47.2	225	242	256	91	48	81	s w b w	s s w	s E	46.00	2.0	1.300	...	Do.	Clear.	Clear. [thun.
24	742	29.609	654	54.8	76.3	61.2	355	548	473	84	62	88	s s E	s E	s E b E	302.40	2.0	3.643	...	C. C. St. 6.	Cu. C. Str. 2.	Cu. Str. 10.
25	467	376	438	56.0	62.8	51.0	413	453	341	90	80	89	s s E	w s w	w s w	264.80	3.5	0.400	...	C. Str. 9.	Do. 4.	Do. 8.
29	584	738	889	49.0	52.9	44.8	292	302	234	82	76	80	w s w	w s w	w	397.80	2.5	...	...	Do. 8.	C. Str. 2.	Do. 8.
27	30.045	975	079	33.7	49.7	41.8	162	223	228	84	64	87	w	w s w	s w	316.04	2.0	0.437	...	Clear frost.	Do. 2.	C. C. Str. 6.
28	29.667	940	30.225	39.7	47.0	34.2	210	280	170	86	88	87	N b w	N w	w b N	77.60	3.0	...	...	Cu. Str. 10.	Do. 8.	C. C. Str. 6.
29	30.106	30.155	224	31.6	44.2	34.2	140	196	155	84	68	79	w s w	w b s	N w b w	225.40	1.5	...	...	Clear frost.	Do. 10.	C. Str. 10.
30	317	324	335	31.0	48.4	34.0	130	236	175	74	70	89	w s w	w s w	s	48.00	2.0	...	...	Do.	Clear.	Clear.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—OCTOBER, 1860.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M.D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.			Tension of Vapour.			Humidity of Air.			Direction of Wind.			Horizon'l Movem't in 24 hrs. In miles.	Mean of Ozone. (tenths)	Rain in Inches.	Snow in Inches.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.					6 A.M.	2 P.M.	10 P.M.
1	30.202	30.161	29.912	27.0	42.8	39.6	.129	.209	.232	.88	.75	.95	E	S	S S E	67.70	2.5	1.039	...	1st frost, clear	Rain.	Rain.
2	29.973	29.992	30.026	39.0	49.0	43.8	232	297	269	95	84	93	W S W	W S W	W b N	14.42	2.5	...	...	Cu. Str. 10.	Cu. Str. 6.	Cu. Str. 10.
3	30.119	30.188	140	43.1	53.9	49.0	261	288	315	95	70	89	W S W	W	W b W	8.30	1.0	...	...	Do. 9.	Do. 9.	Do. 9.
4	084	29.981	29.955	45.6	46.8	46.0	233	305	286	95	96	92	N E b E	N E b E	N E b E	333.20	1.5	0.480	...	Rain.	Rain.	Do. 10.
5	29.903	789	868	46.5	53.7	45.0	305	341	275	96	83	92	S b E	W S W	W N W	158.70	2.0	0.051	...	Cu. Str. 4.	Cu. Str. 8.	Clear.
6	980	956	30.105	36.0	48.7	35.6	170	253	156	80	74	75	N W b W	N W b W	W	345.20	1.5	...	...	Cirri Str. 4.	Clear.	Do.
7	923	752	29.564	36.4	50.3	49.0	184	254	315	85	65	89	S S W	S W	S E b E	17.90	2.0	0.010	...	Clear.	C. C. Str. 6.	Cu. Str. 10.
8	220	218	333	41.4	49.3	39.6	251	247	188	96	71	77	N E	W	W	321.90	3.0	0.800	...	Rain.	Do. 6.	Clear. Au. Bo.
9	334	441	467	37.9	47.7	40.0	193	267	197	85	81	78	W b S	W b N	N b E	411.90	1.5	...	...	Cu. Str. 10.	Cu. Str. 8.	Cu. Str. 10.
10	479	446	434	37.6	53.0	52.4	193	251	294	86	63	79	S W	S	S b E	130.60	1.5	...	...	C. C. Str. 4.	Cir. Cum. 8.	Do. 8.
11	198	633	765	52.0	51.2	39.0	321	252	195	86	68	82	S b E	W	W b N	414.70	1.0	Inap.	...	Cu. Str. 6.	C. Str. 10.	Do. 2. Au.Bo.
12	820	785	893	32.4	50.0	41.0	168	258	212	95	71	82	W S W	S S W	S W	78.80	1.0	...	...	Clear. w frost.	C. C. Str. 8.	Clear, Ft. A.B.
13	950	900	30.100	31.6	51.4	38.1	149	296	186	84	79	81	W	W S W	S W b W	76.30	1.0	...	...	" "	Clear.	Do. do.
14	30.300	30.185	124	30.5	52.0	40.6	148	208	197	89	53	78	W S W	S W	S	105.70	1.0	...	...	" "	Cu. Str. 6.	Cu. Str. 10.
15	29.985	29.894	29.878	57.0	38.1	36.2	164	165	197	76	77	95	N E	N E	W S W	50.70	2.5	0.100	1.10	Cu. Str. 10.	Rain.	Do. 10.
16	865	750	798	34.1	57.5	51.0	182	302	302	95	66	82	W S W	W S W	W b S	164.40	3.5	0.196	...	Clear, w frost.	Cu. Str. 4.	Rain.
17	964	30.074	30.184	40.3	54.2	41.0	210	308	241	86	74	95	E N E	N E b E	N E b E	156.00	2.0	...	...	Cu. Str. 4.	Do. 8.	Cu. Str. 2.
18	30.229	224	216	36.2	58.2	43.0	191	394	254	90	82	92	N E b E	N E b E	S b E	105.20	1.5	...	...	C. C. Str. 8.	Clear.	Clear.
19	095	069	140	36.0	63.7	47.9	179	416	280	87	72	88	S	S W b S	N E b N	64.50	1.0	...	...	Clear, w frost.	Cu. Str. 2.	Do.
20	263	200	274	36.3	49.3	39.2	170	175	180	80	50	77	N E b E	N E b E	N E b E	330.50	1.5	...	...	C. C. Str. 4.	Do. 4.	Cir. Cum. 2.
21	080	29 989	29.930	35.3	54 2	40.6	160	308	241	78	74	95	N E b E	N E b E	N E b E	232.80	2.5	2.522	...	Do. 6.	Rain.	Cu. Str. 10.
22	29.919	954	978	44.0	47.2	45.6	289	225	299	1.00	70	99	N E b E	N E b E	N E b E	254.80	4.0	...	...	Cu. Str. 10.	C. Str. 10.	Clear.
23	986	814	756	44.4	54.2	48.7	289	335	310	1.00	80	92	N E b E	N E b E	N b W	138.60	4.5	...	...	Hazy.	Do. 10.	Cir. Str. 10.
24	660	657	752	43.4	54.6	50.0	254	362	335	92	87	93	S W	W S W	S W	110.20	2.5	...	0.17	Cu. Str. 10.	C. C. Str. 4.	C. C. Str. 8.
25	800	814	825	49.7	59.1	51.2	341	317	350	96	62	90	S S W	S S W	S E b S	42.00	1.5	...	...	Do. 00.	Do. 6.	Clear.
26	673	756	976	49.3	54.2	40.3	341	231	203	96	55	82	S E b S	W b N	N N W	14.50	2.0	0.843	...	Rain.	Cu. Str. 10.	Do.
27	30.103	30.156	30.339	32.6	55.0	37.0	162	349	190	89	81	84	W	S S W	S E b E	69.60	1.0	...	...	Clear, w frost.	Clear.	Do.
28	313	214	168	32.7	51.0	46.8	162	283	256	89	78	81	N E b E	N E b E	S S E	191.50	1.5	...	...	Cu. Str. 4.	Cu. Str. 8.	Cu. Str. 10.
29	031	026	048	45.3	51.6	50.5	293	368	354	96	96	96	S W	S W	W b N	218.40	4.0	0.746	...	Rain.	Do. 10.	Do. 6.
30	168	122	098	46.1	55 0	50.6	305	355	354	97	84	96	E b S	N E b E	N E b E	60.70	3.0	...	...	Cu. Str. 10.	Do. 10.	C. C. Str. 6.
31	080	003	060	49.9	70.1	62.0	335	469	549	93	67	97	E b S	E b S	E S E	144.40	1.5	...	...	C. C. Str. 6.	Do 6.	Clear.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—NOVEMBER, 1860.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M.D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32° 6 A.M.	2 P.M.	10 P.M.	Temp. of the Air. 6 A.M.	2 P.M.	10 P.M.	Tension of Vapor. 6 A.M.	2 P.M.	10 P.M.	Humidity of Air. 6 A.M.	2 P.M.	10 P.M.	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Horizon'l Movem't in 24 hrs. In miles.	Mean of Ozone. (tenths)	Rain in Inches.	Snow in Inches.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0. 6 A.M.	2 P.M.	10 P.M.
1	30.097	30.114	30.176	61.3	68.4	62.6	.498	.513	.523	.91	.79	.94	s E b E	E S E	E	70.80	2.0	Inap.	...	Cu. Str. 10.	Cu. Str. 10.	C. C. Str. 6.
2	121	205	189	51.5	54.3	48.2	411	302	310	97	87	91	N E b E	N E b E	N E b E	268.50	2.5	...	...	Do. 10.	Do. 10.	Cu. Str. 4.
3	168	29.901	29.871	46.0	66.1	55.3	280	536	403	80	84	93	N E b E	N E b E	E N E	145.90	1.5	...	...	Do. 10.	Do. 4.	Do. 10.
4	29.442	624	715	50.5	53.3	43.2	354	244	231	96	60	83	s w b w	W	w s w	317.00	3.0	0 903	...	Nim. 10.	Do. 4.	Clear. Aur.Bo.
5	599	617	721	39.0	52.7	44.6	201	232	241	86	60	84	W	W	E S E	178.50	1.5	...	...	Clear.	C. C. Str. 6.	Cu. Str. 10.
6	691	656	679	41.5	42.3	38.1	235	199	208	91	74	91	S E	E N E	w s w	48.70	3.0	0 546	...	Cu. Str. 10.	Rain.	Rain.
7	770	796	947	36.0	38.6	33.3	191	186	164	90	80	85	W	W N W	w b N	365.70	3.5	0 211	...	Rain.	Cu. Str. 10.	Clear.
8	30.000	979	30.000	31.3	43.6	40.0	155	218	201	89	66	86	w s w	w s w	N E b E	106.70	1.5	...	...	Clear, w frost.	C. C. Str. 8.	Cu. Str. 9.
9	29.997	886	29.845	37.1	47.5	33.3	206	212	168	95	74	90	W	S W	S W	17.20	2.0	...	...	C. C. Str. 10.	Clear.	Clear.
10	784	664	500	34.0	44.6	39.1	183	189	216	90	64	91	N E b E	N E b E	N E b E	251.76	3.5	...	...	Do. 6.	C. Str. 10.	Rain.
11	463	456	426	39.1	49.4	40.1	216	297	254	91	85	92	E	N N E	N	208.60	2.5	0.536	...	Cu. Str. 6.	Do. 10.	Cu. Str. 10.
12	515	513	614	39.0	47.3	45.3	208	267	269	90	82	88	w b N	W	N W b N	62.50	2.0	...	...	C. C. Str. 8.	Do. 4.	Do. 9.
13	795	812	887	42.1	46.2	37.3	244	285	199	91	84	89	w b N	w b N	N W	115.70	1.5	...	...	Do. 6.	Do. 2.	Clear.
14	950	950	991	30.1	47.0	34.2	145	232	167	89	73	88	W	w b s	W N W	70.60	2.0	...	...	Clear, w frost.	Clear.	Do.
15	895	917	30.006	35.1	44.2	38.9	143	240	201	70	83	86	N w b w	s w b w	s s w	81.40	2.5	...	...	Cu. Str. 4.	C. C. Str. 10.	Cu. Str. 10.
16	30.045	30.034	055	35.4	41.0	31.8	169	154	155	84	61	89	N E b E	s s w	S	7.40	2.0	...	...	C. C. Str. 6.	Cu. Str. 6.	Str. 1.
17	29.900	29.859	29.697	29.2	36.4	32.7	142	129	162	88	61	84	E N E	N N W	N b w	49.10	2.5	...	...	Do. 4.	Do. 6.	Cu. Str. 10.
18	280	218	323	31.1	35.9	33.4	155	177	168	89	85	89	N E b E	N b E	N E b E	74.30	3.5	Inap	0.15	Snow.	Do. 10.	Do. 10.
19	165	174	230	34.5	38.9	35.2	190	201	199	95	86	96	N E b E	N E b E	S S E	63.60	3.5	0.372	...	Nim. 10.	Do. 10.	Do. 10.
20	180	320	422	36.0	39.3	33.8	186	173	162	86	73	84	S S E	w b N	W N W	238.40	4.0	0.140	...	Cu. Str. 10.	Do. 10.	Do. 9.
21	600	621	801	27.0	30.9	28.7	129	124	146	88	84	90	w s w	w s w	s b w	130.40	2.5	...	...	Do. 4.	Do. 10.	Do. 9.
22	879	869	868	22.4	35.0	32.0	095	162	149	79	80	84	w s w	S W	S W	101.30	2.5	...	...	Do. 8.	Do. 10.	Do. 10.
23	867	797	604	35.0	40.4	37.5	183	203	214	90	82	95	s b w	S E b E	S E b E	228.50	3.0	...	Inp	Do. 10.	Do. 10.	Do. 4.
24	907	135	232	30.1	27.6	22.1	227	105	179	99	70	65	w s w	w s w	w s w	720.00	3.0	3.190	...	Rain.	Sleet.	Do. 6.
25	465	659	972	20.4	21.1	23.2	075	076	106	70	71	86	w b N	w b N	w s w	710.00	2.0	...	...	Cu. Str. 10.	Cu. Str. 6.	Do. 10.
26	30.183	30.142	30.054	13.4	24.7	26.3	057	120	123	72	89	87	w s w	s b w	S S E	546.00	2.5	...	...	Clear.	Do. 6.	Do. 10.
27	29.665	29.580	29.851	32.3	41.0	32.6	162	212	162	89	82	89	s b w	w s w	W	314.00	2.5	...	3.54	Snow.	Do. 6.	Clear.
28	894	890	851	20.8	28.3	19.6	091	129	081	85	82	77	W	N N W	w s w	110.00	2.5	...	...	Clear.	Do. 8.	Do.
29	571	594	502	20.4	34.4	32.0	082	169	160	74	84	88	S W	S W	W	57.10	2.0	...	...	C. C. Str. 4.	Sleet.	Cu. Str. 10.
30	400	314	225	32.1	35.4	33.0	143	160	168	79	87	89	W	W	N E b E	69.10	2.0	Inap	Inp	Cu. Str. 10.	Snow.	Sleet.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR OCTOBER.

Barometer	Highest, the 27th day	30.339
	Lowest, the 11th day	29.198
	Monthly Mean	29.919
	Monthly Range	1.141
Thermometer	Highest, the 31st day	70°.1
	Lowest, the 1st day	26°.1
	Monthly Mean	45°48
	Monthly Range	44° 0
Greatest Intensity of the Sun's Rays		85°.0
Lowest Point of Terrestrial Radiation		22°.2
Mean of Humidity		.839
Amount of Evaporation		1.32

Rain fell on 11 days, amounting to 6.787 inches; it was raining 69 hours and 44 minutes.

Snow fell on 2 days, amounting to 1.27 inches; it was snowing 11 hours.

Most prevalent wind, the N. E. by E.

Least prevalent wind, the E.

Most windy day, the 11th day; mean miles per hour, 16.88.

Least windy day, the 3rd day; mean miles per hour, 0.23.

Aurora Borealis visible on 4 nights.

The Electrical state of the Atmosphere has indicated high tension.

Two distinct and smart shocks of an earthquake were felt here at 5.55 a.m. on the morning of the 17th day, the wave passing from E. to W. The sound wave was distinctly perceptible after the passage of the earth wave.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR NOVEMBER.

Barometer	Highest, the 2nd day	30.205
	Lowest, the 24th day	28.950
	Monthly Mean	29.730
	Monthly Range	1.255
Thermometer	Highest, the 1st day	71°.4
	Lowest, the 26th day	12°.0
	Monthly Mean	37°.59
	Monthly Range	59°.4
Greatest Intensity of the Sun's Rays		82°.1
Lowest Point of Terrestrial Radiation		12°.0
Mean of Humidity		.839

Rain fell on 10 days. amounting to 5.898 inches; it was raining 48 hours 29 minutes.

Snow fell on 4 days, amounting to 3.69 inches; it was snowing 7 hours and 50 minutes.

Most windy day, the 24th: mean miles per hour, 29.35.

Least windy day, the 16th. mean miles per hour, 0.33.

Most prevalent wind, the S. W.

Least prevalent wind, the E.

Aurora Borealis visible on 1 night.

The Electrical state of the Atmosphere has indicated constant and moderate intensity.

The Symmetrical wave was well marked during the month.

Snow birds (*Plectrophanes Nivalis*) first seen on the 3rd day.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR AUGUST, 1860.

Barometer	Highest, the 15th day	30.070
	Lowest, the 30th day	29.459
	Monthly Mean	29.760
	Monthly Range	0.611
Thermometer	Highest, the 10th day	92°2
	Lowest, the 12th day	39°3
	Monthly Mean	69°29
	Monthly Range	52°9
Greatest Intensity of the Sun's Rays		110°6
Lowest point of Terrestrial Radiation		31°1
Mean of Humidity		.740

Amount of Evaporation, 3.02 inches.

Rain fell on 13 days, amounting to 9.361 inches; it was raining 51 hours and 44 minutes, and was accompanied by thunder and lightning on two days.

Meteor in E. 5th day, at 8.45 p. m.

Meteor in S. 12th day, at 8.30 p. m.

Solar rainbow 19th day.

Lunar Rainbow at 8 p. m. 25th day.

Most prevalent wind, the S. W.

Least prevalent wind, the S.

Most windy day, the 26th day; mean miles per hour, 10.70.

Least windy day, the 2nd day; mean miles per hour, 0.20.

Aurora Borealis visible on 10 nights.

The electrical state of the atmosphere has indicated high intensity.

Solar Halo visible on 16th day at 9.30 a. m.

Slight frost on the morning of the 12th day.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR SEPTEMBER, 1860.

Barometer	Highest, the 30th day	30.335
	Lowest, the 25th day	29.376
	Monthly Mean	29.885
	Monthly Range	0.959
Thermometer	Highest, the 15th day	83°9
	Lowest, the 30th day	25°5
	Monthly Mean	56°48
	Monthly Range	58°4
Greatest intensity of the Sun's rays		105°6
Lowest point of Terrestrial Radiation		20°1
Amount of Evaporation		2.90
Mean of Humidity		.777

Rain fell on 13 days, amounting to 11.230 inches; it was raining 58 hours 36 minutes, and was accompanied by thunder and lightning on two days..

Solar Halo 14th day.

Lunar Corona and imperfect Halo 27th day.

Very slight snow fell on the 29th day. Inappreciable, the first of the season.

Sharp frost on the mornings of the 29th and 30th days.

Morning Rainbow on the 20th day.

Most prevalent wind, the W. S. W.

Least prevalent wind, the N.

Most windy day, the 26th day; mean miles per hour, 18.86.

Least windy day, the 2nd day; mean miles per hour 0.00

Aurora Borealis visible on 5 nights.

The Electrical state of the Atmosphere has indicated moderate intensity.

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THE PRESIDENT'S ADDRESS.

BY DANIEL WILSON, LL.D.,

PROFESSOR OF HISTORY AND ENGLISH LITERATURE, UNIVERSITY COLLEGE, TORONTO.

Read before the Canadian Institute, January 13th, 1861.

GENTLEMEN OF THE CANADIAN INSTITUTE,

It was with a high appreciation of the honor conferred on me that I acknowledged on a former occasion the distinction of being elected by you to fill this Chair, which had already been successively occupied by men whose names reflect a dignity on any one who may succeed to them; and it is with feelings not less appreciative of the kindness with which you have marked your sense of my hearty zeal in all that pertains to the progress of the Canadian Institute, that I have again to thank you for this renewed testimony of your favor in placing me a second time in the high position of your President.

It is usual on such anniversaries as this to review the more important events which have recently transpired in the world of science; and especially to note what progress has been made within our own Province. During the past year, however, the interest and the energies of Canada have been largely absorbed in proceedings, which, while they had for their special object the inaugural completion of that gigantic triumph of engineering skill which now spans the St. Lawrence, and challenges comparison with the greatest mechanical

achievements of ancient or modern times; were chiefly pregnant for all of us with moral and social influences of a high order, though deriving their value from elements apart from those with which Science has chiefly to deal. Now that the glare and excitement attendant on the visit to our colony of the Heir apparent to the British Throne have passed away, and we can look calmly back on that event which gave birth to such enthusiastic demonstrations in every corner of this wide Province, I feel assured that many realize the elevating influences which are begotten by the awakening of pure and lofty sentiments of patriotism and loyalty; and reflect with unalloyed pleasure on the feelings of generous and affectionate interest with which they looked on that son of our loved and gracious Queen on whom rest the future hopes of this great empire. Amid all the cordial expressions of loyalty which greeted our Prince in his progress through this Province, none, I feel assured, were more heartfelt and sincere than those in which the members of this Institute gave utterance to their earnest prayer: that, endowed with all noblest graces and divine blessings, trained in sound learning, and gifted with a liberal love of Science and the Arts, he might be eminently fitted for the high trust of which he is the heir.

Happily it is still our boast that, while, under the genial sway of our beloved Queen, science and letters are accomplishing triumphs which will render the Victorian era illustrious in future ages, we participate in all the glories of that empire—the mother of future nations,—which is now girdling the world with a glorious confederacy of provinces, alike united in freedom, in intellectual progress, and in loyal devotion to their sovereign head; so also, as members of an Institute specially devoted to investigations and researches into the hidden truths of nature, we claim an interest in all the triumphs which mark the progress of Science, wheresoever achieved. In attempting a *résumé* of progress since our last anniversary, I may accordingly be expected to refer to the alleged addition to our solar system of the new planet Vulcan, as one of the most popular among recently announced discoveries. The names of Le Verrier and Adams are indissolubly associated with that beautiful demonstration which, reasoning from the known forces Newton had revealed, determined the existence of the unseen planet Neptune, and with a prescience based on true scientific faith, dictated the precise point in the heavens where, amid the infinite multitudes of stars which the tele-

scope reveals, the astronomer should find the unknown wanderer, that, afar on the verge of our solar system, obeyed the same laws which hold our earth within its annual path, and control the fulfilment for us of the divine promise that "while the earth remaineth, seed time and harvest, cold and heat, summer and winter, and day and night shall not cease."

The perturbations of Uranus had long warned the astronomer of some unknown element present within the remote confines of the system; and more recently the distinguished French discoverer of Neptune had given expression to the belief that certain disturbances in the movements of the planet Mercury must be attributed, in all probability, to a similar cause: when the scientific world was startled by the announcement that, at the opposite extreme of our solar system, within the burning zone which intervenes between Mercury and the sun, the intra-mercurial planet Vulcan had been seen, revolving around the common solar centre within a period of nineteen days and seventeen hours, at a distance from the sun not exceeding eight degrees, and with a mass only one-seventeenth of that of Mercury. The glimmering twilight of Neptune, wandering in its remote orbit, the outer sentinel of our system, long withheld it even from the gaze of the astronomer; and we await the confirmation of this announcement of another planet, still longer hidden in the burning splendor of its orbit by excess of light. But if it should prove true, it will not diminish our interest in the result, that the discovery is due to the self-taught labors of M. Lescarbault, an humble amateur astronomer, working with rude instruments of his own construction.

But from this I pass to other researches in Astronomical Science in which we may claim some personal interest. The year which has closed was specially marked to the Astronomer by a total eclipse of the sun, on the 18th of July, the line of central shadow of which extended from a point near Vancouver's Island eastward to the Labrador Coast, and after traversing the Atlantic, passed across Spain and Northern Africa, terminating finally at the southern extremity of the Red Sea. On this continent, accordingly, an Astronomical expedition was organized by the accomplished superintendent of the U. S. Coast Survey, for the purpose of observing the eclipse at Cape Chudleigh, on the Coast of Labrador, and included in its staff, as a representative of Canadian Science, one of our own members, Lieut. E. D. Ashe, R.N., the director of the Quebec Observatory.

Exposed to unusually tempestuous weather, and precluded from some of the most important observations by the intervention of a thin veil of cloud between them and the sun just previous to its total immersion, the expedition to the Coast of Labrador has not contributed any novel truths to science. The intervening cloud, though but a fleecy veil, of utmost insignificance at any other moment, was sufficiently dense to almost entirely preclude the observation of the corona usually seen surrounding the moon during the period of total eclipse. It was the good fortune of Lieutenant Ashe alone, of all the observers, to catch a single point of brightness and fix its position in the corona; and thus to supply one precise observation for comparison with those simultaneously made in other parts of the globe. But it is of interest to us to know that our New World of the West bore its part, and our own young Province had its representative among those devotees of science who were engaged at widely separate stations: at Hereña, near Miranda de Ebro, and at Tarazona, in Spain, as well as at other favourable points along the line traversed by the great shadow; in watching the phases of this beautiful and rare phenomenon. Among the most striking results hitherto communicated to the scientific world, are the observations made under the direction of Le Verrier, at Tarazona; though in one respect an interesting correspondence is noticeable between the phenomena noted by the members of the French Astronomical expedition, and those which attracted the attention of the observers on our own Labrador Coast. At the period of total obscuration alike at Cape Chudleigh, and at Tarazona, the general illumination of the atmosphere proved much greater than the relations of former observers had led either party to anticipate. But the more important phenomena recorded by Le Verrier, are: first, the observation of three lofty peaks, 30° below the horizontal diameter on the eastern edge of the solar disc,—of the reality of the toothed form of which the French Astronomer entertains no doubt,—with their upper sides tinged with rosy and violet light, while the lower sides were brilliant white; and secondly, but of more importance, that as the moment of reappearance of the sun approached, and while watching for its first rays, the previously white margin of the disc appeared tinged with a delicate fillet of unappreciable thickness, of a purplish red, which enlarged by degrees until it formed around the black disc of the moon, over a breadth of about 30°, a red border perfectly defined in thickness, crescent shaped, and with an irregular outline

above. The visible part of the emergent sun over its whole breadth and up to the height of seven or eight seconds, was covered by a bed of rosy clouds, which appeared to gain in thickness as they emerged from behind the disc of the moon. Without enlarging on other phenomena noted by the French astronomer, it may suffice here to note that Le Verrier has been led by those to the entire re-construction of the theory hitherto maintained relative to the physical constitution of the sun; and, discarding the idea of a central dark globe, with successive opaque and luminous cloudy or gaseous envelopes, he now inclines to the belief that the sun is a body, luminous simply because of its high temperature, and covered by an unbroken layer of roseate matter, the existence of which he conceives his observations have demonstrated. Other observers, including those who watched the eclipse at Hereña, still adhere to the opinion that the corona and the luminous clouds are alike ascribable to simple optical appearances; and we must not only be content to wait the full publication of the results of the various independent observations, but in all probability reserve for the disclosures of future eclipses, the determination of some of those interesting questions relative to the physical constitution of that central sun which rules the undisputed sovereign of our system, dictates laws to the remotest planet, curbs the blazing comet in his far-wandering aphelion, and measures life, and time, and changing seasons, to all the worlds revolving in its train.

But from this department of the history of scientific progress during the past year, in which Canada has been honorably represented, though on a scale greatly inferior to what a just ambition would lead us to desire, I turn to glance at another sphere of labor. Among recent actions connected with the practical applications of science, most nearly related to our own immediate sympathies, none is, perhaps, calculated to awaken a deeper interest than the expedition of Sir Leopold McClintock to survey the projected North Atlantic route for a new telegraphic cable between Great Britain and America. It recalls to us the memory of high hopes wrecked in the very hour of triumph. After repeated disappointments, and when every mind was prepared for failure, we all remember when, on the fifth of August, 1858, the news flashed along all telegraphic lines on the American continent that the *Niagara* and *Gorgon* steamers had reached Trinity Bay with their portion of the Atlantic cable intact; and on the same memorable fifth of August the *Agamemnon* communicated by its means the

equally successful completion of her moiety of the work. The magnitude of the triumph of Science seemed to impress with a solemn awe the humblest actors in this great event. The hardy seamen who bore the cable to land, knelt together and united their voices in prayerful recognition of a divine and overruling Providence to whose aid they ascribed it that their labor had not been in vain; and the English board—abandoning the cold formalities of a joint-stock company,—despatched to the American directory the telegram, memorable in its form as in its news:—EUROPE AND AMERICA ARE UNITED BY TELEGRAPH; GLORY TO GOD IN THE HIGHEST, ON EARTH PEACE, GOOD WILL TO MEN.

The great pulse of the empire throbbed in sympathy with that of the proud young western nation kindred with itself, and the common ancestral blood seemed to kindle anew into generous aspirations, with the consciousness that time and space had been annihilated, and the broad Atlantic no longer severed them and us from the vital heart of Britain's world-wide empire. Science had her triumph. The costly experiment proved beyond all doubt the possibility of laying electric wires along the depths of the ocean's bed, and of transmitting the electric current through their vast length of cable. But, that accomplished, all waited impatiently—and as it proved, in vain,—for the practical working of the wondrous telegraphic line. It had uncoiled its voluminous folds, and stretched its mighty length across the submarine valleys of the ocean, like some fabled leviathan, only to mock us as with an enchanted sleep. The wealth of thousands was embarked in the vessels freighted with its folds; the hopes of millions were awakened by the calm unheralded announcement of its triumph; and the most unimaginative reflected with a glow of pleasurable wonder on the noiseless freight of human thought speeding on the wings of the lightning through the dark abysses of the ocean. But there is, perhaps, something even more calculated to awaken our just admiration in the fact that, undaunted by so costly a failure, the indomitable enterprise of England has resumed the task, and will never rest till her Canadian sons, and her American kin, are united with her by this grand electric chain. In the expedition which sailed in the *Bulldog* and the *Fox* for the purpose of resuming this great work, Canada also had her representative in Dr. John Rae, a distinguished associate of our own body, who had already been the pioneer of Sir Leopold McClintock in the nobler task which he accomplished

in the previous voyage of the *Fox* to Arctic Seas. But, exposed to the same tempestuous weather which impeded the astronomical expedition to the Coast of Labrador, the voyage of the *Bulldog* and *Fox* was accomplished under circumstances calculated to warn us that such triumphs are not to be won without toil and disappointment. Continuous bad weather retarded the survey, though it could not thwart the persevering energy of those entrusted with its execution; and they effected a series of soundings sufficient to demonstrate the practicability of an Atlantic cable carried from the north of Scotland to the Faroe Islands, thence to the east shore of Iceland, and from its western coast along a sea-bed over which the annual icebergs of the Arctic Ocean sweep southward their mighty hulks, like mountains torn from their foundations, to waste and perish as strange intruders in a southern clime.

But while we are thus encouraged to anticipate once more, with eager longing, the time when the ocean-buried coil shall emerge on our own British American coasts, and its wondrous freight of thought shall sweep across half a world, swift and noiseless as the stellar rays through the blue depths of space; we have meanwhile other results of interest and value to note, as products of this great enterprise. Dr. Wallich, the naturalist of the expedition, has recently published a valuable series of observations, having for their chief object to determine the depths to which animal life extends in the sea. The result of these is to establish beyond question that life exists in the vast depths of the ocean, under circumstances which have heretofore been deemed incompatible with any condition of vitality. The soundings in the bed of the Atlantic had previously made us familiar with the fact that the oozy deposits along its great basins are to a considerable extent made up of the minute calcareous shells of Foraminifera. But these have been obtained during the recent expedition, at depths of from fifty to nearly two thousand fathoms, with the cell-contents entire, and otherwise presenting satisfactory evidence of having been in a vital state when disturbed in their ocean habitats by the sounding line and lead. Nearly midway between Cape Farewell and Rockall, the deep-sea line brought up, along with numerous specimens of the Globigerinæ, several living star-fishes belonging to the genus Ophiocoma, recovered from a depth of upwards of twelve hundred fathoms. The facts are highly suggestive and replete with interest for us. That in the dark caverns of mid-ocean, the solid rock was in process

of formation out of the minute calcareous shells of some of the most simply organised families of the animal kingdom, was a fact already established, in full accordance with all the phenomena of geological history already revealed to us. The main subject disclosed in those wonderful lithological chronicles of the preadamite world which palæontology reveals, is the history of the beds of former seas. But in addition to this we now learn of organic life abundantly present under conditions hitherto deemed incompatible with any forms of vitality; and of contemporaneous zones of life immensely extending its assigned range. Science has long since revealed to us the fact that we ourselves live—and require such a condition as an element essential to life,—in the depths of a great atmospheric ocean, which subjects us to a pressure of fourteen pounds on the square inch, or to a mean weight of 21,240 pounds. But from those latest disclosures of submarine life it is proved that in deep zones of the ocean, upwards of two miles from its surface, where the feeblest refraction of sunlight can scarcely be supposed to shed a glimmering ray, and the pressure must amount to more than a ton and a half on the square inch, not only the minute Foraminifera, but highly organized species of radiata, revel in the enjoyment of life, and sport their strange forms and brilliant colours, in ocean's dark unfathomed caves. To the lamented Edward Forbes we owe some adequate appreciation of the comprehensive truths which the intelligent use of the dredge places within reach of the naturalist, and we may now regard those results of deep ocean soundings, carried on under such peculiar disadvantages, as a mere glimpse and fortaste of the disclosures which await us relative to a new submarine fauna. There strange and beautiful forms reveal glimpses to us of the infinite variety of characters in which God is still writing the revelations of his creative power to shame the petty cavils of the sceptic, and invite our study of new zones of life at depths to which light itself can scarcely penetrate, but from which science thus recovers vital truths, calculated to illuminate many obscurities in that great geological past, built up out of the wrecks of still older life and organization. Whilst so many are watching with eager, though bated hope, the prospect of practical results to the political and commercial world from this new Atlantic Telegraph expedition, less tantalizing and evanescent than those which were celebrated with such joyous pæans, when the "bridal clasp" and the magnetic "wedding ring" were believed to have plighted perpetual troth between Britain

and her western scions: it is something to know that Science has gained new and important truths, interesting and replete with promise, alike for the Old World and the New.

Thus it is that in pursuing one line of inquiry we are almost imperceptibly led into another and seemingly totally independent one. Thus it is that the connexion of the physical sciences is ever revealing itself in new phases; and with every extension of our knowledge we are the more taught to recognize in them an intimately related sister-band. Geology and Natural History, Astronomy, Electricity, and Magnetism, are all found to have their points of contact, and mutually minister to each others completeness, while each presents its special claims on our sympathy and interest. In the observation of magnetic phenomena, and the patient accumulation of data calculated to determine the solar magnetic influence on the earth, the laws of periodicity connected with terrestrial magnetic force, and the search for those hidden truths which comprehend the mysterious power by which the electrician already triumphs over time and space, Toronto, with its efficient staff of workers at the Provincial Observatory, already takes a prominent place. The novel truths to which Le Verrier's observations seem to point relative to the physical constitution of the sun involve new views, which if once established must modify the whole theory of solar magnetic influence, and lead to further investigations of the apparent relations between the changes observed on the cloudy envelope of the solar photosphere, and the periodical changes of variation in the elements of the earth's magnetic force. Theory and observation go hand in hand in demonstrating the physical characteristics of the sun, and the influences which control the genial despotism with which that luminary reigns supreme, the monarch of our system. The accelerated motion of Enke's comet at each return has sufficed to suggest the abandonment of the idea that planetary and cometary motions are performed in vacuo, and leads to the belief that space is everywhere pervaded by an ether, too rare to effect a perceptible change on the motions of the planets, but sufficient by its resistance to subject such attenuated substances as the comets more completely to the attractive force of gravity, and urge them onward, with an ever diminishing orbit and increasing velocity, until they fall into the sun. These strange wanderers of the heavens that sweep at times their streaming train across the sky, "with fear of change perplexing nations," are thus shown, in their attenuated

fragility, like some frail moth irresistibly attracted towards the solar lamp; and fluttering ever nearer and nearer around the light until it is consumed. Yet it is not less true of that grand theatre of action where suns and planets move in stately order, than of this little world of ours:

> "That not a worm is cloven in vain;
> That not a moth with vain desire
> Is shrivell'd in a fruitless fire."

Already it has been suggested by Professor William Thompson, of Glasgow, that such may be the means by which the solar fires are replenished, and the central luminary of our system is maintained in undiminished brightness, while raying forth light and heat to all its planetary train. Such a phenomenon is believed to have been recently independently observed by two distinguished English astronomers, Mr. Carrington and Mr. Hodgson, who chanced by a happy coincidence to be simultaneously engaged at their different observatories in watching a group of solar spots. Two intensely luminous bodies were seen suddenly to burst into view, and to move within a period of a few minutes through a space on the solar disc of about 35,000 miles, during which they attained their maximum brightness and then faded away, without affecting the forms of the group of solar spots which lay directly in their path. Lord Wrottesly, while drawing the attention of the British Association, at its recent Oxford meeting, to this interesting contribution of his own favorite science, failed not to note the remarkable coincidence that the simultaneous observations at Kew show on the same day, at the very hour and minute of this unexpected and curious phenomenon, the occurrence of a marked magnetic disturbance. Nor will it, I feel assured, fail to interest you when I state that on applying to my colleague Professor Kingston, he informs me that the register of the Provincial Magnetic Observatory records a corresponding magnetic disturbance at Toronto within a few seconds of the same time.

Thus are we stimulated anew to watch with intelligent sympathy and interest the patient and little-heeded labors of our own Canadian magnetic observers, as day by day they silently note the minutest variations in the phenomena connected with this mysterious force, and strive to wrest from nature the hidden secrets of this uncomprehended power. Yet that is not an altogether uncomprehended power, in the operations of which we already recognize a law of the Universe,

alike relating itself to the economic appliances of science in the telegraphic lines of daily commercial intercourse, and bearing its part in the grand triumphs of intellect by which we reach forth to grasp at truths written for us in the central sun, in the revolving planets, and amid the wondrous galaxy of stars that stretch away in mysterious magnificence into the infinite depths of space, until imagination and reason tremble alike in the vain effort to conceive of a finitude for that visible Universe, by which the heavens declare the glory of God, and nightly utter knowledge of Him who alone is truly infinite.

But the subsidiary labours already referred to in connection with the Atlantic Telegraphic expedition bring us into relation with another branch of scientific labour in which Canada maintains a no less efficient staff of workers. The novel and interesting truths of Natural History revealed by the deep-sea soundings conducted under the guidance of Sir Leopold McClintock and Dr. Wallich, not only greatly enlarge the sphere of organic life, and open up an ample field for fresh explorations of the naturalist in those deep zones of the ocean which have hitherto been assumed to present conditions incompatible with organic life: but they are calculated to throw fresh light on the palæontology of the long emerged terra firma; and, with their accumulated calcareous shells of the minute Foraminifera, amounting, in some of the specimens of soil brought up from the profound depths of the ocean bed, to 95 per cent. of the whole mass; and their highly organized and brilliantly tinged living radiata and mollusca: to illustrate the processes by which vast strata which now invite the study of the geologist, were slowly accumulated in the abysses of the primeval ocean.

The distinguished geologist who so honorably presides over the labours of our provincial corps of observers, and whose former occupance of this chair reflects an honor on the humblest of his successors, is peculiarly devoid of that ambition which, among scientific workers on both sides of the Atlantic, is seen to tempt some from the patient fidelity to their legitimate pursuits, in the search for showy but often worthless disclosures that win the temporary meed of vulgar applause. He rather exhibits to us in a preeminent degree the example of a modest and patient searcher after those hidden truths of nature, the full worth of which will only be fully appreciated when other generations have entered into his labours; and it is then seen how largely such earnest and faithful verification of the thousand isolated facts of

his young science have contributed to supply the missing links of that great chain by which we are reaching back from the living present into that infinite past through which creative power has manifested itself in ever varying forms and conditions in the succession of life. Nevertheless all the recognition of Sir William Logan's indefatigable labours is not left for posthumous appreciation. Owing to some special advantages which the geological formations of Canada supply, the researches of our provincial staff have largely aided in throwing a new and clearer light on those Azoic rocks which by their essentially inorganic character appear to point clearly to a terrestrial era prior to the first creation of life; and thus to offer a scientifice confirmation to that initial stage of creation in which the earth was without form, and void. Sir Roderick Murchison in his recent reclassification of the more ancient rocks of Scotland,* when referring to those on the North West Scottish coast, remarks: "The phenomenon relating to these Cambrian sandstones, which may well strike the geologist, is that these very ancient rocks, on which unquestionably the Lower Silurian rocks repose, should be simply sandstones and grits which have undergone much less change than the sandstone which lies upon them,—the latter having been metamorphosed into quartz-rock. However difficult it may be to account for this fact, it is at all events most instructive as regards the origin nd succession of life in the crust of the earth, and sustains my view of a beginning. For here the older of the two rocks in Scotland has offered no trace of fossils, whilst the more crystallized structure above exhibits unmistakeable signs of former living things." Having accordingly set forth in detail the evidence and reasoning on which he bases his new views on the order of the ancient stratified rocks of Scotland, and their associated eruptive rocks, Sir Roderick Murchison thus proceeds: "The beginning of the geological alphabet, as applied in the maps of the Geological Survey to the Cambrian rocks of England, Wales, and Ireland, must therefore be preceded in Scotland by the first letter of some alphabet earlier than the Roman, showing a still lower deep in the north-west of Scotland—as in North America,—than exists in England, Wales, or Ireland. If this most ancient gneiss required a British name, it might indeed, with propriety, be termed the *Lewisian System*, seeing that the large island of Lewis is essentially composed

* Proceedings of the Geological Society, Vol. XVI., page 240.

of it; but the term *Laurentian* having been already applied to rocks of this age in North America by our distinguished associate, Sir Wm. Logan, I adhere to that name, the more so as as it is derived from a very extensive region of a great British Colony."

Thus geology is pointing with accumulating proofs to the beginnings of terrestrial life; while we are reminded by familiar evidence around us in many of the Canadian rocks, that at the commencement of those fossil records in the Laurentian strata, trilobites, and other crustacea abound; and we are now assured, by the most recent disclosures of science, that the bed of the present ocean is the arena of many inferior forms of organic life. Here therefore the accumulating evidence seems to force upon us the adoption, or rather the firmer retention, of opinions altogether at variance with those novel views on the nature and origin of species, to which I had occasion to refer when last addressing you from this Chair. But the questions in relation to the origin of species, which were then beginning to attract the attention of men of science, have during the past year excited a more general interest than any other purely scientific inquiry.

When the views of DeMaillet, Oken, and Lamarck were reproduced in a popular form, it was not altogether without reason that the argument was affirmed to place science in conflict with religion. It seemed like an attempt, if not to dispense entirely with a supreme creative power and divine first cause, at least to reduce to the smallest conceivable minimum the controlling government of an ever-present, overruling providence; and to demonstrate a universe which having been constructed like some ingenious piece of mechanism, wound up, and set agoing, was thenceforth capable of working out its results without further oversight, until the term of its mechanical forces was exhausted, and the finger, stopping of itself on the great dial, declared that time shall be no more. The theories of spontaneous generation and the modification of organized beings by external physical agents, or by the direct operation of their own voluntary acts, have indeed found advocates among those honestly in search of guiding lights towards the hidden laws and truths of nature; but they have maintained but a feeble hold on the earnest students of science, and have for the most part been diluted into popular forms of scepticism in which all recognition of a providential government of the universe has been ignored. But the novel and highly suggestive views on the origin of species by means of natural selection, are presented to us

under very different auspices. We cannot treat them with too sincere respect even while rejecting them. They are no rash and hastily formed fancies of a shallow theorist, but the earnest convictions of an eminent English naturalist of great and varied experience, set forth as deductions based on a continuous series of observations and experiments, extending over upwards of twenty years; and heralded by the favourable testimony of some of the most cautious and discriminating among his scientific contemporaries. Nevertheless, the time which has been already allowed for the critical investigation of such evidence as is advanced to sustain his comprehensive hypothesis, has only tended to discredit his transmutation theory, and add assurance to the convictions of the scientific believer in the idea of creation as the only satisfactory solution of the succession of life. Science has achieved wondrous triumphs, but life is a thing it can neither create nor account for, by mere physics. Nor can we assume even that the whole law of life can be embraced within the process of induction, as carried out by an observer so limited as man is, in relation to the sequence of time, and to the cosmical changes by which so much of the record is erased. Darwin, indeed, builds largely on hypotheses constructed to supply the gaps in the geological record; but whilst welcoming every new truth which enlarges our conception of the cosmic unity, all nature still says as plainly to us as to the Idumean patriarch: "Canst thou by searching find out God? canst thou find out the Almighty to perfection?"

Assuredly it is in no spirit of sceptical presumption that Darwin has set forth his views; and I heartily accord with the claim advanced by Professor Huxley, that the arguments of an experienced and profound naturalist on pure questions of science, must be met on scientific grounds alone. But when science claims not only to disclose the nature of all living and extinct organizations, but to determine their primary origin, it is difficult even on purely scientific grounds, to avoid reasserting the truth which all nature audibly affirms, that creation owes its existence to a Creator. And at every appearance of new organic forms in the geological strata of the earth, science sacrifices no jot or tittle of its true dignity, when owning a higher law, it admits that He who, in the beginning, created the heavens and the earth, has in like manner put forth the same creative power at every successive origination of species.

The geologist in reasoning on the succession of life, has hitherto

appealed to palæontological evidence by which he traces every specific form through provinces of space uniform in their relations to the order of geological strata, and therefore determinate as to the relative period of time within which they sprung into being, ran their appointed course, and were superseded by new orders of life. Yet it is not to be doubted that the record is very imperfect, and so leaves room for piecing it out with theory, hypotheses, and a comprehensive generalization. Nor need we affirm that the Lamarckian idea of an abnormal organic power of self-development; or that which assigns to external influences a modifying power on the characters of species: is wholly unsupported by observation. Neither these, nor the opinions set forth by Darwin in favour of the derivation of well determined forms of one period from others more or less diverse in earlier formations, are altogether unsustained by evidence; though they can carry us but a short way in accounting for, or determining the plan of creation. They may induce us to reject the claims of many specific variations in organic form to be ranked as distinct primary species; but they leave the grand questions of the origin of species and the source of organic life, precisely where they were. We are still free to look upon the successive orders of life as the manifestations of an intelligent creative power: the intellectual conceptions of the supreme Intelligence by whom the universe subsists, wrought out, like all else in His visible creation, by material means.

But leaving this aspect of the question, I rather turn to the consideration of the bearing of the bold naturalist's views on the origin of man himself. Drawing his ingenious theories to a close he exclaims: "The whole history of the world, as at present known, although of a length quite incomprehensible by us, will hereafter be recognised as a mere fragment of time, compared with the ages that have elapsed since the first creature, the progenitor of innumerable extinct and living descendants, was created. In the distant future I see open fields for far more important researches. Psychology will be based on a new foundation, *that of the necessary acquirement of each mental power and capacity by gradation.* Light will be thrown on the origin of man and his history. Authors of the highest eminence seem to be fully satisfied with the view that each species has been independently created. To my mind it accords better with what we know of the laws impressed on matter by the Creator, that the production and extinction of the past and present inhabitants of the

world should have been due to secondary causes, like those determining the birth and death of the individual. When I view all beings not as special creations, but as the lineal descendants of some few beings which lived long before the first bed of the Silurian system was deposited, they seem to me to become ennobled." But apart from what I cannot avoid characterizing as the monstrous notion that any new system of physiology can account for the origin of the intellect and living soul of man by development: the question is not whether man in reality acquires a scientific patent of nobility by tracing his ancestry back through the Gorilla or the Chimpanzee, to some vital monad that had its being ages before the first bed of the Silurian system was deposited; but whether science affords the slightest countenance to such a pedigree. If the origin of species be really traceable to natural selection and the preservation of favoured races in the struggle for life, then it should be demonstrable that man is pre-eminently favoured in physical organization, for he has every where triumphed over all other animals. But that triumph has been the result of no such physical preeminence, but of that intellectual power bestowed on him when—as we believe on an authority to which the progress of science adds ever fresh confirmation,—God breathed into him the breath of life, and man became a living soul.

In defining the contrasting gifts of instinct and reason which distinguish the lower animals from man, it was remarked by one whose death has robbed life to me of one of its greatest charms,—one, let me add, who found his earnest faith in things divine confirmed by every step he advanced in scientific knowledge :—"Our working instincts are very few; our faith in them is still more feeble; and our physical wants far greater than those of any other creature. Had the assembled lower animals been invited to pronounce upon what medical men call the 'viability,' or managers of insurance offices 'the chances of life' of the first human infant, their verdict would have been swift, perhaps compassionate, but certainly inexorable. The poor little featherless biped, pitied by the downy gosling, and despised by the plumed eaglet, would have been consigned to the early grave, which so plainly in appearance awaited him; and no mighty Nimrod, with endless lion-slaying hunter-sons, would have been seen to dawn in long perspective above the horizon, and claim the fragile infant as their stalwart father. Yet the heritage of nakedness, which no animal envies us, is not more the memorial of the innocence that once was

ours, than it is the omen of the labours which it compels us to undergo. With the intellect of angels, and the bodies of earth-worms, we have the power to conquer and the need to do it."*

Viewing man thus exercising dominion over the inferior creation by no preeminence of physical power, but solely by intellectual supremacy, we can no more conceive of the development of the brute into man,—dowered with reason, capable of intelligent faith, the heir of immortality,—than we can conceive of the conversion of inorganic matter into the very lowest forms of organic life, without the intervention of creative Omnipotence.

Nevertheless truth is ever the gainer by the collision of opinions, and the most important results may be anticipated in reference to the Science of Ethnology, from the revision of the whole question as to the origin and nature of species, consequent on the discussion to which the theories of Darwin have given rise. The increasing proneness towards the unlimited multiplication of species has unquestionably tended to the cumbrance instead of the elucidation of every department of zoology; and the minute subdivisions which naturalists have latterly favoured, have given an undue force not only to such general arguments as those of Darwin in relation to organic life, but to the theories of modern ethnologists by which the genus *homo* has been divided into an ever growing multiplicity of species. If we take the typical man of each of Blumenbach's comparatively simple divisions, we cannot evade the conclusion that very clearly defined elements of diversity furnish grounds for the classification into Caucasian, Ethiopian, Mongolian, Malayan, and American. But the simplicity of this system has secured for it no permanent adoption. Pickering, the able ethnologist of the United States exploring expedition, after examining, as he believes, every variety of the human race, rejects the idea that the American Red Man is distinct from the Asiatic Mongolian, and yet redivides the human family into eleven essentially distinct races, or species. "There is" he adds, "no middle ground between the admission of eleven distinct species in the human family, and the reduction to one." But other ethnologists, while pursuing the same course, have manifested even less favour for any middle ground. Borey de St. Vincent divides mankind into fifteen species; Broc greatly enlarges this by numerous sub-genera; and Gliddon and Nott,

* What is Technology?—An Inaugural Lecture. By George Wilson, M.D., F.R.S.E. Regius Professor of Technology, Edinburgh University.

following out the suggestion of Agassiz as to the correspondence of different species of men with the natural geographical areas of the animal kingdom, divide the globe into eight zoological realms, throughout which their human fauna are distributed under forty-three different heads; and it is by no means apparent that this is an exhaustive division into species of the genus *homo*.

Looking to the tendency of such views to an ever-widening multiplicity of species, or races of men, and to the consequent diminution in a corresponding ratio, of the elements of difference between them, it is impossible, I conceive, to overlook the force of some of Darwin's arguments in their bearing on this momentous question. Take, for example his favourite illustration, the domestic pigeon; we look in vain for the slightest trace of the transmutation of a bird of another genus into any one of the varied and widely-scattered breeds of the wild or domestic pigeon, whatever force we may recognise in the arguments by which he traces all alike back to the Columba livia. Pigeons, he shows, have been domesticated for thousands of years. Lepsius indicates the record of them on the monuments of Egypt in the fifth dynasty, some three thousand years before Christ; Birch traces them in an Egyptian bill of fare of a still earlier date; Pliny refers to their extravagant cost among the luxurious Romans; Akber Khan maintained them by thousands; and the monarchs of Iran and Turan deemed them fitting gifts for the lordly Sultan. The same wild breed of pigeons has been found capable of domestication in northern Europe, and in India, and is seen to agree in habits and in numerous points of structure with all the domestic breeds; yet, says Darwin, "although an English carrier or short-faced tumbler differs immensely in certain characters from the rock-pigeon, by comparing the several sub-breeds of these breeds, more especially those brought from distant countries, we can make an almost perfect series between the extremes of structure." Finally he adds: "It is also a most favourable circumstance for the production of distinct breeds, that male and female pigeons can be easily mated for life." But we have only to remember that those, and all the other elements referred to, are to a far higher extent characteristic of man. Domestication and a social settled life, the permanent mating in pairs, the migration in communities, the external influences of an artificial civilization and highly diverse climatic influences for thousands of years, have all pertained to his normal condition, and may all therefore be made to

yield still stronger proofs that the man of Europe, of Egypt, and of India, are alike descended of one primal stock.

In relation to the psychological aspect of the question, and the possible acquirement of each mental power and capacity by gradation, one argument has forcibly impressed my own mind, whatever value it may appear to possess to others. In recently carrying out some minute investigations into the characteristics of the languages of this continent, I have been struck with the confirmation which those of the Red Indian nations supply to the well known philological truth, that while vocabularies are simple in the early stages of intellectual development, and acquire their complex character with the progress of the nation: grammar on the contrary appears more full, complete, and harmoniously consistent, the further back it is traced. Selecting one of the native languages of our western forests, we find among the rude children of nature, destitute of all science, and ignorant even of letters, no rudimentary combination of half-developed utterances, the transitional stage between brute cries and human speech; but a language having systematised grammatical forms as rich, regular, and consistent, as that in which Plato wrote, and Homer sung. Such perfection of organization in languages, devoid of all abstract terms, of the whole vocabulary of mental science, and of generic symbols of that classification which accompanies the recognition alike of the laws of external nature and of thought, is utterly irreconcileable with those ideas of development once more offered for our acceptance on such high authority, and of a grand futurity, wherein "all corporeal and mental endowments will tend to progress towards perfection," by the natural selection of favoured races in the struggle for life.

In thus attempting, however inadequately, to review the recent progress of knowledge, with a special relation to our own Province, I have aimed at recalling to your notice alike those labours in the cause of science, during the past year, in which we possess some personal interest, and those novel and suggestive theories which have most recently given a new impulse to thought. We claim, as associates of this Institute to rank as lovers of science, united for the investigation of the laws of nature, and the discovery of new truths in every department of human knowledge. We desire also to rank as workers, and to associate with us all the workers in the same noble cause. It would indeed be a grave reflection on this Province, dowered with the inestimable blessings of a fertile soil, a hardy yet genial climate, and

above all, with free institutions which are the envy of less favoured lands: if, amid all its eager pursuit of material wealth, it could point to no phalanx of labourers aiming at the increase of the wealth of mind; to none who covet being sharers in that glorious advancement of knowledge by which God, who has revealed himself to us in his word, is making ever new revelations of himself in his works; and having made known to us Him who is the wisdom and the power of God, through whom we have the assurance of life and immortality in the gospel of his grace; is anew, in the great volume of nature, adding fresh evidence of man's immortality, by revelations of the inexhaustible wonders of that creation, which, I doubt not, is to employ the purified and enlarged faculties of man in its study through all the ages of that future life to which it is his attribute to aspire. May we, while seeking here the pure and elevating enjoyments which spring from the discovery of nature's truths, find knowledge of the humblest works of God an incitement to the adoration and love of Him, whom to know is life eternal.

ON THE THEORY OF TYPES IN CHEMISTRY.

BY T. STERRY HUNT, M.A., F.R.S.

In the *Annalen der Chemie und Pharmacie* for March, 1860, (cxiii., 293) Mr. Kolbe has given a paper on the natural relations between mineral and organic compounds, considered as a scientific basis for a new classification of the latter. He objects to the four types admitted by Gerhardt, namely, hydrogen, hydrochloric acid, water, and ammonia, that they sustain to organic compounds only artificial and external relations, while he conceives that between these and certain other bodies there are natural relations having reference to the origin of the organic species. Starting from the fact that all the bodies of the carbon series found in the vegetable kingdom are derived from carbonic acid with the concurrence of water, he proceeds to show how all the compounds of carbon, hydrogen and oxygen may be derived from the type of an oxide of carbon, which is either C_2O_4, C_2O_2, or the hypothetical C_2O.

When in the former we replace one atom of oxygen by one of

hydrogen we have C_2O_3H, or anhydrous formic acid; the replacement of a second equivalent would yield $C_2O_2H_2$, or the unknown formic aldelyde; a third, $C_2O{\cdot}H_3$, the oxide of methyle; and a fourth, C_2H_4, or formene. By substituting methyle for one or more atoms of hydrogen in the previous formula, we obtain those of the corresponding bodies of the vinic series, and it will be readily seen that by introducing the higher alcoholic radicals we may derive from C_2O_4 the formulas of all the alcoholic series. A grave objection to this view is however found in the fact that while this compound may be made the type of the aldehydes, acetones, and hydrocarbons, it becomes necessary to assume the hypothetical C_2O_2, HO, as the type of the acids and alcohols. Oxide of carbon, C_2O_2, is according to Kolbe, to be received as the type of hydrocarbons like olefiant gas, (C_2HMe,) while C_2O, in which ethyle replaces oxygen, is C_6H_5 or lipyle, the supposed triatomic base of glycerine.

The monobasic organic acids are thus derived from one atom of C_2O_4, while the bibasic acids, like the succinic, are by Kolbe, deduced from a double molecule C_4O_8, and tribasic acids, like the citric, from a triple molecule C_6O_{12}. He moreover compares sulphuric acid to carbonic acid, and derives from it by substitution the various sulphuric organic compounds. Ammonia, arseniuretted and phosphuretted hydrogen, are regarded as so many types; and by an extension of his view of the replacement of oxygen by electro-positive groups, the ethylids ZnEt, $PbEt_2$, and $BiEt_3$, are, by Kolbe, assimilated to the oxides of ZnO, PbO_2, and BiO_3.

Ad. Wurtz, in the *Repertoire de Chimie Pure* for October, 1860, has given an analysis of Kolbe's memoir, (to which, not having the original before me, I am indebted for the preceding sketch) and follows it by a judicious criticism. While Kolbe adopts as types a number of mineral species, including the oxides of carbon, of sulphur and the metals, Wurtz would maintain but three, hydrogen, (H_2) water, (H_2O_2) and ammonia, (NH_3); and these three types, as he endeavoured to show in 1855, represent different degrees of condensation of matter. The molecule of hydrogen, H_2 (M_2), corresponding to four volumes, combines with two volumes of oxygen (O_2) to form four volumes of water, and may thus be regarded as condensed to one-half in its union with oxygen, and derived from a double molecule, M_2M_2. In like manner four volumes of ammonia contain two

volumes of nitrogen and six of hydrogen, which, being reduced to one-third, correspond to a triple molecule, M_3M_3, so that these three types and their multiples are reducible to that of hydrogen more or less condensed.—(WURTZ, *Annales de Chimie et de Physique*. (3) xliv. 304).

As regards the rejection of water as a type of organic compounds, and the substitution of carbonic acid, founded upon the consideration that these in nature are derived from C_2O_4, Wurtz has well remarked that water, as the source of hydrogen, is equally essential to their formation, and indeed that the carbonic anhydrid C_2O_4, like all other anhydrous acids, may be regarded as a simple derivative of the water type. Having then adopted the notion of referring a great variety of bodies to a mineral species of simple constitution, water is to be preferred to carbonic anhydrid, first, because we can compare with it many mineral compounds which can with difficulty be compared with carbonic acid; and secondly, because the two atoms of water being replaceable singly, the mode of derivation of a great number of compounds (acids, alcohols, ethers, etc.,) is much more simple and natural than from carbonic acid. As Wurtz happily remarks, Kolbe has so fully adopted the theory of types that he wishes to multiply them, and even admits condensed types, which are, however, molecules of carbonic acid and not of water; "he combats the types of Gerhardt and at the same time counterfeits them."

Thus far we are in accordance with Mr. Wurtz, who has shown himself one of the ablest and most intelligent expounders of this doctrine of molecular types, as above defined, now almost universally adopted by chemists. He writes,—"to my mind this idea of referring to water, taken as a type, a very great number of compounds, is one of the most beautiful conceptions of modern chemistry."—(*Repertoire de Chimie Pure*, 1860, p. 359); and again, he declares the idea of regarding both water and ammonia as representatives of the hydrogen type, more or less condensed, to be so simple and so general in its application that it is worthy "to form the basis of a system of chemistry.—(*Ibid.* p. 356.)

We have in this theory two important conceptions: the first is that of hydrogen and water regarded as types to which both mineral and organic compounds may be referred; and the second is the notion of condensed and derived types, according to which we not only

assume two or three molecules of hydrogen or water as typical forms, but even look on water as the derivative of hydrogen, which is itself the primal type.

As to the history of these ideas, Wurtz remarks that the proposition ennunciated by Kolbe that all organic bodies are derived by substitution from mineral compounds is not new, but known in the science for about ten years. "Williamson was the first who said that alcohol, ether, and acetic acid were comparable to water—organic waters. Hoffman and myself had already compared the compound ammonias to ammonia itself." * * * "To Gerhardt belongs the merit of generalizing these ideas, of developing them, and supporting them with his beautiful discovery of anhydrous monobasic acids. Although he did not introduce into the science the idea of types, which belongs to M. Dumas, he gave it a new form which is expressed and essentially reproduced by the proposition of Kolbe. Gerhardt reduced all organic bodies to four types—hydrogen, hydrochloric acid, water and ammonia.—(*Ibid*, p. 355.)

The historical inaccuracies of the above quotation are the more surprising since in March, 1854, I published in the *American Journal of Science*, (xvii. 194) a concise account of the progress of these views. This paper was re-published in the *Chemical Gazette*, (1854, p. 181,) and copies of it were by myself placed in the hands of most of the distinguished chemists of England, France and Germany. In this paper I have shown that the germ of the idea of mineral types is to be found in an essay of Auguste Laurent, (*Sur les Combinaisons Azotées, Ann. de Chimie et Physique*, Nov., 1860,) where he showed that alcohol may be looked upon as water (H_2O_2) in which ethyle replaces one atom of hydrogen, and hydric ether as the result of a complete substitution of the hydrogen by a second atom of ethyle. Hence he observed that while ether is neutral, alcohol is monobasic and the type of the monobasic vinic acids, as water is the type of bibasic acids. In extending and developing this idea of Laurent's, I insisted in March, 1848, and again in January, 1850, upon the relation between the alcohols and water as one of homology, water being the first term in the series, and H_2 being in like manner the homologue of acetene and formene, while the bases of Wurtz were said to "sustain to their corresponding alcohols the same relation that ammonia does to water." (*Am. Jour. Sci.* v. 265; ix. 65; xiii. 206.)

In a notice of his essay, published in September, 1848, (*Ibid*, vi., 173) I endeavored to show that Laurent's view might be farther extended, so as to include in the type of water "*all those saline combinations (acids) which contain oxygen*;" and in a paper read before the American Association for the Advancement of Science at Philadelphia, in Sept., 1848, I farther suggested that as many neutral oxygenized compounds which do not possess a saline character are derivatives of acids which are referable to the type H_2O_2, "*we may regard all oxygenized bodies as belonging to this type*," which I farther showed in the same essay, is but a derivative of the primal type H_2, to which I referred all hydro-carbons and their chlorinized derivatives, as also the volatile alkaloids, which were regarded "as amidized species" of the hydro-carbons, in which the residue amidogen, NH_2, replaced an atom of H or Cl., or what is equivalent, the residue NH was substituted for O_2 in the corresponding alcohols. (Ibid viii., 92.)

In the paper published in Sept., 1848, I showed that while water is bibasic, the acids which like hypochlorous and nitric acids were derived from it by a simple substitution of Cl and NO_4 for H, were necessarily monobasic, and I then pointed out the possible existence of the nitric anhydrid $(NO_4)_2O_2$, which was soon after discovered by Deville. Gerhardt at this time denied the existence of anhydrids of the monobasic acids, while he regarded anhydrids as characteristic of polybasic acids, and indeed was only led to adopt my views by the discovery of the very anhydrids whose formation I had foreseen.*

In explaining the origin of bibasic acids I described them as produced by the replacement, in a second equivalent of water, of an atom of hydrogen by a monobasic saline group; thus sulphuric acid would be $(S_2HO_6H)O_2$. Tribasic acids in like manner are to be regarded as derived from a third equivalent of water in which a bibasic residue replaces an atom of hydrogen. The idea of polymeric types was further illustrated in the same paper, where three hydrogen types were proposed, (HH) (H_2H_2) and (H_3H_3) corresponding to the chlorids MCl, MCl_2 and MCl_3. It was also

* The anhydrids of the monobasic acids correspond to two equivalents of the acid, minus one of water, as, $2(C_2 H_4 O_4) - H_2 O_2 = C_8 H_6 O_6$, while one equivalent of a bibasic acid (itself derived from $2(H_2 O_2)$ loses one of water, and becomes an anhydrid as $C_2 H_2 O_6 - H_2 O_2 = C_2 O_4$. So that both classes of anhydrids are to be referred to the type of one molecule of water $H_2 O_2$.

illustrated by sulphur in its ordinary state, which I showed is to be regarded as a triple molecule S_3, (or $S_6 = 4$ volumes) and referred sulphurous acid SO_2 to this type, to which also probably belongs selenic oxide. (At the same time I suggested that the odorant form of oxygen or ozone was possibly O_3.) Wurtz in his memoir, published in 1855, adopts my view, and makes sulphur vapour at 400° C the type of the triple molecule. I farther suggested (*American Journal of Science,* v. 408, vi. 172,) that gaseous nitrogen is NN, an anhydrid amid or nitryl, corresponding to nitrite of ammonia, (NO_3, NH_4O) — H_4O_4 = NN. This view a late writer attributes to Gerhardt, who adopted it from me, (*Ann. de Chimie et Phys,* lx. 381.) May not nitrogen gas, as I have elsewhere suggested, regenerate under certain conditions, ammonia and a nitrite, and thus explain not only the frequent formation of ammonia in presence of air and reducing agents, but certain cases of nitrification ?*

I endeavoured still further to show that hydrogen is to be looked upon as the fundamental type from which the water type is derived by the replacement of an atom of H by the residue HO_2, (*American Journal,* viii. 93.) In the same way I regarded ammonia as water in which the residue NH replaced O_2.

I have always protested against the view which regards the so-called rational formulas as expressing in any way the real structure of the bodies which are thus represented. These formulas are invented to explain a certain class of reactions, and we may construct from other points of view, other rational formulas which are equally admissable. As I have elsewhere said "the various hypotheses of copulates and radicals are based upon the notion of dualism, which has no other foundation than the observed order of generation, and can have no place in a theory of science." All chemical changes are reducible to union (identification,) and division (differentiation). When in these changes only one species is concerned, we designate the process as metamorphosis, which is either by condensation or by

* The formation of a nitrite in the experiments of Cloez appears to be independent of the presence of ammonia, and to require only the elements of air and water (*Comptes Rendus.*) Some experiments now in progress lead me to conclude that the appearance of a nitrite in the various processes for ozone, is due to the power of nascent oxygen to destroy by oxydation the ammonia generated by the action of water on nitrogen, the nitrous nitryl; so that the odor and many of the reactions assigned to ozone or nascent oxygen are really due to the nitrous acid which is set free when the former encounters nitrogen and moisture. On the other hand, nascent hydrogen, which readily reduces nitrates and nitrites to ammonia, by destroying the regenerated nitrite of the nitryl, produces ammonia in many cases from atmospheric nitrogen.

expansion, (homogeneous differentiation.) In metagenesis, on the contrary, unlike species may unite, and by a subsequent heterogeneous differentiation give rise to new species, constituting what is called double decomposition, the results of which, differently interpreted, have given origin to the hypothesis of radicals and the notion of substitution by residues, to express the relations between the parent bodies and their progeny. The chemical history of bodies is then a record of their changes; it is in fact their genealogy, and in making use of typical formulas to indicate the derivation of chemical species, we should endeavour to show the ordinary modes of their generation. (See *On the Theory of Chemical Changes*, *Am. Jour. Sci.* xv. 226, L. E. & D. *Phil. Mag.* (4) v. 526, and *Chem. Centralblatt*, 1858, p. 849. Also *Thoughts on Solution*, *Am. Jour. Sci.* xix. 100, and *Chemical Gazette*, 1855, p. 92.

Keeping this principle in mind let us now examine the theory of the formation of acids. As we have just seen I taught in 1848 that the monobasic, bibasic and tribasic acids are derived respectively from one, two and three molecules of water, H_2O_2. Mr. Wurtz, seven years later, (in 1855) put forth a similar view. He supposes a monatomic radical PO'_4 a diatomic radical $P''O_3$, and a triatomic radical PO'''_2, replacing respectively one, two and three atoms of hydrogen in H_2O_2, H_4O_4, and H_6O_6, thus $(PO'_4H)\,O_2(PO''_3H_2)O_4$ and $(PO'''_2H_3)O_6$. These radicals evidently correspond to PO_5 which has lost one, two and three atoms of oxygen in reacting upon the hydrogen of the water type, and these acids may be accordingly represented as formed by the substitution of the residue $PO_5—O$ for H, etc.

To this manner of representing the generation of polybasic acids we object that it encumbers the science with numerous hypothetical radicals, and that it moreover fails to show the actual successive generation of the series of acids in question. When phosphoric anhydrid, $P_2O_{10}=(PO_4)_2O_2$, is placed in contact with water it combines with one equivalent, H_2O_2. The union is followed by homogeneous differentiation, and two equivalents of metaphosphoric result, $(PO_4)_2O_2+H_2O_2 = 2\,(PO_4H)O_2$. Two equivalents of this acid with one of water at ordinary temperatures are slowly transformed into two of pyrophosphoric acid, by a reaction precisely similar to the last. $2\,(PHO_6) = (PHO_5)_2O_2 + H_2O_2 = 2\,(PHO_5H)O_2$, and two equivalents of pyrophosphoric acid when

heated with a third equivalent of water yield, in like manner, two of tribasic phosphoric acid; $2\,(PH_2O_7) = (PH_2O_6)_2O_2 + H_2O_2 = 2\,(PH_2O_6H)O_2 = 2\,PH_3O_8$.

Gerhardt long since maintained that we cannot distinguish between polybasic salts and what are called sub-salts, which are as truly neutral salts of a particular type. Thus the bibasic and tribasic phosphates are to be looked upon as subsalts, which sustain the same relation to the monobasic phosphates that the basic nitrates bear to the neutral nitrates. He succeeded in preparing two crystalline subnitrates of lead and copper, having the formulas NO_5,M_2O_2,HO (tribasic), and NO_5,M_4O_4,H_2O_2 (quadri or heptabasic), both of which retain their water of composition at 392° F. The compounds of sulphuric acid are: 1st. The true monobasic sulphate S_2O_6MO, corresponding to the Nordhausen acid and the anhydrous bisulphates; 2nd. The ordinary neutral sulphates, S_2O_6, M_2O_2; 3rd. The so-called disulphates, S_2O_6, M_4O_4, corresponding to the glacial acid density 1·780; 4th. The type, S_2O_6, M_6O_6, represented by turpeth mineral; and, 5th. The so-called quadribasic sulphates, $S_2O_6M_8O_8$. The copper salt of this type, according to Gerhardt, retains, moreover, 6HO at 392° F.—(*Gerhardt on Salts, Jour. de Pharmacie*, 1848, vol. xii.; *Am. Jour. Sci.* vi. 337.)

Without counting the still more basic sulphates of zinc and copper, described by Kane and Schindler, we have the following salts, which in accordance with Wurtz's notation, correspond to the annexed radicals:

1. Monobasic	S_2HO_7	$=S_2O_6$	monatomic.
2. Bibasic	$S_2H_2O_8$	$=S_2O_4$	diatomic.
3. Quadribasic............	$S_2H_4O_{10}$	$=S_2O_2$	tetratomic.
4. Sexbasic	$S_2H_6O_{12}$	$=S_2$	hexatomic.
5. Octobasic................	$S_2H_8O_{14}$	$=S_2-O_2$	octatomic.

It is easy to apply a similar *reductio ad absurdum* to the radical theory in the case of the oxychlorids and other basic salts, and to show that the radicals of the dualists are often merely algebraic expressions.—(See further my remarks in the *Am. Jour. Science*, vii. 402—404.)*

* Those who are familiar with chemical literature, will remember an amusing *jeu d'esprit* of Laurent's, in which he invited the attention of the advocates of the radical theory to a newly invented electro-negative radical *Eurhizene.—Comptes Rendus des Travaux de Chimie* for 1850, pp. 251 and 376.) We observe a late writer in the *Chemical News* (vol. i. p. 226) proposing, as a new electro-negative radical, under the name of hydrine, the peroxyd of hydrogen HO_2, the eurhizene of Laurent!

The above, which we conceive to be a simple statement of the process as it takes place in nature, dispenses alike with hypothetical radicals and residues, both of which are, however, convenient for the purposes of notation. In the selection of a typical form, to which a great number of species may be referred, hydrogen or water merits the preference from its simplicity, and from the important part which it plays in the generation of species. Water and carbonic anhydrid are both so directly concerned in the generation of the bodies in the carbon series, that either may be assumed as the type, but we prefer to regard C_2O_4, like the other anhydrids, as only a derivative of the type of water, and eventually of the hydrogen type.

These views were first put forward by myself in 1848, when I expressed the opinion that they were destined to form "the basis of a true natural system of chemical classification;" and it was only after having opposed them for four years to those of Gerhardt, that this chemist, in June 1852, renounced his views, and without any acknowledgment, adopted my own.—(*Ann. de Chim. et Phys.* (3) xxxvii. 285.) Already in 1851, Williamson, in a paper read before the British Association, had developed the ideas on the water type to which Wurtz refers above, and to him the English editor of *Gmelin's Handbook* ascribes the theory. The notion of condensed types, and of H_2 as the primal type, was not, so far as I am aware, brought forward by either of these, and remained unnoticed until resuscitated by Wurtz in 1855, seven years after I had first announced it, and one year of my reclamation, published in the *American Journal of Science*, in March, 1854.

My claims have not, however, been overlooked by Dr. Wolcott Gibbs. In an essay on the polyacid bases, he remarks that in a previous paper, he had attributed the theory of water types to Gerhardt and Williamson, and adds, "in this I find I have not done justice to Mr. T. Sterry Hunt, to whom is exclusively due the credit of having first applied the theory to the so-called oxygen acids and to the anhydrids, and in whose earlier papers may be found the germs of most of the ideas on classification usually attributed to Gerhardt and his disciples."—(*Proc. Am. Assoc.* Baltimore, May, 1858, p. 197.) It will be seen, from what precedes, that I not only applied the theory, as Dr. Gibbs remarks, but except so far as Laurent's suggestion goes, invented it and published it in all its details some years before it was accepted by a single chemist.

In conclusion, I have only to ask that future historians will do justice to the memory of Auguste Laurent, and will ascribe to whom it is due the credit of having given to the science a theory which has exercised such an important influence in modern chemical speculation and research, remembering that my own publications on the subject, which cover the whole ground, were some years earlier than those of Williamson, Gerhardt Wurtz, or Kolbe.

MONTREAL, *January*, 1861.

NOTICES OF BIRDS OBSERVED NEAR HAMILTON, C. W.

BY THOMAS MC'ILWRAITH, ESQ.

Continued from page 18.

The small family of *Marsh blackbirds* is next in order, two species of which are well-known on account of their gaudy colours. One is the Red-winged Blackbird so common in our marshes during summer, and the other is the *Baltimore Oriole*, whose pensile nest we sometimes see suspended from the drooping twigs of our willow shade trees. The former of these enjoys the unenviable reputation of being a notorious corn thief, and though several writers have endeavoured to clear his character from this imputation, yet if brought to the Bar on such a charge, we might expect to hear very strong condemnatory evidence given against him by the farmer, and unless he could succeed in getting upon the jury a majority of his friends, the *Crow Blackbirds*, who had themselves tasted the corn, the chances are that the case would go against him. Admitting, however, that he does occasionally take what was intended for others, he amply compensates for it by the destruction of innumerable grubs and caterpillars, whose ravages among the corn would have far exceeded his own. A more remarkable species than either of these is the *Cow Bunting*, which, like the British Cuckoo, builds no nest, but dropping its egg into that of another bird, leaves the care of its offspring to those not related to it, even by family ties. With us, the Cow-birds are summer residents only, usually making their appearance about the beginning of April, and retiring to the south about the end of October.

It is possible that a few individuals may spend the winter with us, in sheltered situations; as when visiting a farm house near Dundas, early in March (1857,) I was surprised to see half a dozen of these birds nestling close together on a beam just above the cattle in the cow-house. On enquiry, I found they had been there all winter, coming out for a few hours about midday, and gleaning seeds from among the fodder of the cattle. They were all males, and seemed in excellent condition.

It was long a subject of remark among those who were fond of observing the habits of birds, that the nest of the Cow Bunting was seldom, if ever, found, and suspicions were entertained that some irregularity existed in their mode of perpetuating their race, but Wilson was the first to establish the fact, that they not only shirk the duties of incubation, but that the whole tribe live in a state of the most unrestrained polygamy. Their conduct, in this respect, forms a striking contrast to that of all our other summer birds: these, as soon as they arrive from their winter quarters, lay aside the instinct which has kept them in flocks during their migratory course, and scattering about in pairs, each pair makes choice of a particular tree or bush, which is to be their home for the season. To this spot they are devotedly attached, and near it the male may be constantly seen, either cheering his mate with a song, or fighting bitter battles of disputed boundary with his troublesome neighbours. Even the Woodpeckers, which, some writers say, have the smallest share of enjoyment of all the feathered tribes, may at this season be seen chattering and chasing each other round the favorite decayed tree, whose hollow recess is to be the cradle for their young. During all this excitement, the Cow-birds remain in a state of callous indifference, and in small flocks, keep roaming about the clearings like bands of vagrants, with no song save a few spluttering notes, holding no intercourse with other birds, and with no attachment to any locality, save that where food is most abundant.

As the season of incubation advances, the female Cow-bird leaves the flock, and having made choice of a nest to suit her purpose, deposits therein one egg, and leaves it, not only without hesitation, but, judging from her manner, with evident satisfaction. The nest so selected is usually that of a Fly-catcher or Warbler, in which the owner has just made a similar deposit. Wilson, who spent much time in investigating this matter, tells us, that the egg of the Cow-bird is

hatched in less time than the others, and that the female being obliged to leave the nest to provide for the wants of the youngster, the unhatched eggs are exposed to the weather, and do not come to maturity, but, in a few days, disappear altogether, leaving the intruder in undisputed possession of the nest. It has ever been a puzzle to naturalists to account for this singular habit, and as it may be interesting to hear what has been said on the subject, I will here make one or two short extracts.

Wilson, after devoting more space to the description of this than any other bird he met with, says, "what reason nature may have for this extraordinary deviation from the general practice, is, I confess, altogether beyond my comprehension. Many conjectures, indeed, may be formed as to the probable cause, but all of them, which have occurred to me, are unsatisfactory and inconsistent. Future and more numerous observations may throw some light on the matter, till then, we can only rest satisfied with the fact." Mr. Selby, the eminent English naturalist, suggests, regarding this habit in the Cuckoo, that the old birds retire to the south before the young are able to accompany them, and *therefore* they have to be confided to the care of others. The writer of an article on this subject, in the *British Cyclopedia of Natural History*, says regarding Mr. Selby's theory, "this is perhaps about as good an explanation of the Cuckoo's peculiarities as has yet been offered, but it fails, like all the others, in being quite inapplicable to the North American Cow Bunting. The true cause, whatever that may be, of this extraordinary deviation, must, we are persuaded, be the same in both, nor can we at present accept of any explanation as satisfactory, which will not alike apply to either."

I have been particular in making these extracts, because it occurs to me that an important consideration connected with the subject has been overlooked, it is one which applies alike to the Cuckoo and the Cowbird, and will, I think, if carefully followed up, go far to explain the seemingly unnatural conduct of both species. We recognize in it, as in accordance with the all wise laws which regulate animated nature, that over each class there is imposed a salutary check, to prevent excess in production; this is specially observable among the feathered tribes, some of which have their eggs carried away by the ship-load from the breeding places; others, such as the grouse and waterfowl, are greatly reduced in number by sportsmen, or those who make a business of sending them to market, while the finches and blackbirds contribute

largely to the support of the birds of prey, and in the southern part of the continent, are, during the winter, taken in numbers with the net, and sold for the table. None of these causes, however, in any way affect the class which embraces the Fly-catchers and Warblers, as from their small size and the nature of their food, they are not sought after for these purposes. The check which applies to this class must therefore be of a different description from those referred to, and finding no way in which their numbers are reduced to any extent, *except* by the sacrifice made of their own young while rearing that of the Cowbird, leads me to conclude, that the habit has been given for the special purpose of keeping within proper bounds, a class of birds which might otherwise have exceeded their due proportion in the economy of nature. If we suppose the habit to be the result of any physical defect in the Cowbird, we might naturally expect, that it would confide the care of its young to a bird nearly allied to its own species, but in nine cases out of ten, the foster parents belong to a group which are different both in size, habit, and the nature of their food; it is evident therefore that the *result* of the peculiarity is intended by nature to bear specially on the class to which the foster parents belong, and any one who has noticed the flocks of cowbirds which pass along on their migratory course in spring and fall, and estimated that for each bird in these flocks, from three to five of a different class have been prevented from coming to maturity, must admit that it is no small influence which the Cowbird exercises, in maintaining the balance of power which so admirably prevails among the feathered tribes.

If we could imagine such a thing in nature, whose movements are all so well ordered as that the Cow Buntings should at any time get in excess of the other class referred to, it would be curious to estimate the results; the Flycatchers would then be fully occupied in rearing foster children, and not being permitted to perpetuate their own species, must soon die out, when the Cowbirds, finding themselves without a substitute in the rearing of their young, would either be driven by necessity to make the attempt themselves, or they too would soon be added to the list of extinct species.

Passing the *Jays* and the *Crows*, (both of which are well deserving of notice did our limits permit,) we come to a species, which, in our vicinity, is the sole representative of his family.* This is the *American*

* Since writing the above, I have found a second species near the city, which appears to be the *Lanius Excubitoroides* of Baird.

Shrike, or *Butcher Bird*, so called from his habit of impaling his prey on thorns. With us this species appears about the end of September, and a few adults remain over the winter. The male frequently makes choice of a particular district as his hunting ground during his stay, and I am inclined to think returns to it, year after year. His aspect bespeaks both strength and courage, the short neck, broad head, and notched beak giving him much the appearance of a bird of prey. His favourite food consists of grasshoppers and other insects, but in winter when these cannot be procured, he does not hesitate to hunt down the smaller finches, killing them with a blow of his powerful beak. In October last, when passing through an open field west of the race course, I noticed one of these birds, whose motions led me to suspect he was engaged in the occupation which has gained him his name; he was too shy to allow a close inspection of his operations, but on examining the thorn bush I found two of his victims still in life on thespikes. I did not observe anything which could lead to an explanation of this singular habit, except that he seemed to take great delight in the pastime, skipping about between the ground and the bush, and warbling a few rather musical notes in evident token of satisfaction.

To those who have occasion to be in the woods in winter, there is no bird so familiar as the *White Breasted Nuthatch* ; it is one of the few which remain with us all the year round, and is remarkable for its restless inquisitive habits ; as a climber it has no equal, and may often be seen running downward on the smooth bark of a perpendicular tree, a feat which no other Canadian bird ever attempts. An examination of its feet shows a remarkable adaptation for this peculiar habit. It is furnished with a long and strongly hooked hind claw which enables it to hang firmly in that position. It is said to roost head downward, and I have often seen it when shot, hanging in this position after death. The Red-breasted Nuthatch is another species of the same genus ; it resembles the other, but is more migratory in its habits, less in size, and slightly different in colour.

The family of *Woodpeckers* is well represented in our woods, seven different species being observed. Of these the most common are the two spotted varieties, which resemble each other in colour, but differ considerably in size ; they are partially migratory, only a few remaining during the winter. In the fall, when passing along to the south, they are frequently seen on the shade trees of the city,

jerking themselves round to the off side of the branch when observed, or again startling the inmates of our frame dwellings, by rattling loudly on the decaying boards.

A very beautiful species of this family is the *Red Headed Woodpecker*, which has been remarked by those who are observant of our native birds, to be less common in this district than formerly. This can only be accounted for by the removal of the heavy decaying timber which forms the nursery of its favourite insect food, and as the country gets more under cultivation, we may look forward to the time when it will only pay us a passing visit on its way to and from the woody regions to the north of us.

The least common species of this class which I have observed is the *Arctic three-toed Woodpecker.* Wilson does not appear to have met with it all, and Audubon mentions the northern part of the State of New York, as the southern limit of its migration; it resembles the spotted woodpeckers in size and manners, but differs from them in colour, and in wanting the hind toe. Why one class of these birds should have *four toes*, and another, similar to it in habits should have only *three*, we are at a loss to determine. I may remark, however, that the three-toed species belongs exclusively to the north, being seldom found among deciduous trees, and I have no doubt that a careful examination of the feet of this bird, and their mode of application to the bark of the pine, would give a satisfactory explanation of the seeming defect.

Passing the *Pigeons* and the *Grouse*, which are equally interesting to the sportsman and the naturalist, we come to the *Waders* and *Swimmers.* Here my remarks will be general, as the haunts of these birds being beyond the reach of morning excursions I cannot say much from personal observation.

Of the first division of this group, which includes the Plovers, Sand-pipers, Curlews, &c., little can be said, except that they visit the sandy shores of Burlington Beach in considerable numbers every spring and fall, when on their migratory course to and from their summer residence in the north. In spring these visits are usually made during the month of May, occasionally the flocks remain for a day or two, but more frequently they move off after a rest of only a few hours, and are succeeded by others bound on the same journey. By the first of June they have all disappeared except the little Spotted Sand-

piper, which stays with us during the summer, rearing its young on the shores of the bay.

Of the *Heron* family we have four species: viz, the Great Blue Heron, the Black-crowned Night Heron, and the greater and lesser Bitterns. Much information has yet to be gained regarding the birds of this class. Being all more or less night feeders, the study of their habits is attended with peculiar difficulty. On the breast of the great blue heron, covered by the long plumage of the neck is a tuft of soft tumid feathers, which, when exposed in the dark emit a pale phosphorescent light. The use of this does not yet appear to be fully understood, though the fishermen aver that when the heron retires at night to his feeding ground, he wades knee deep in the water, and shewing this light attracts the fish within his reach, much in the same way as the Indian does when fixing the torch of pitch-pine on the bow of his canoe.

Of the flocks of the larger water-fowl which periodically pass along on their migratory course, only a very few now visit us; occasionally, in thick or stormy weather a few stragglers alight on the bay to rest and recruit themselves, though they generally forfeit their lives by so doing. Last fall three specimens of the American Swan were thus procured, and a single individual of what has hitherto been considered the young of the Snow Goose was also obtained; doubts still exist as to the identity of the latter bird, some writers maintaining that it is a separate and distinct species, while others declare it to be the young of the snow goose in immature plumage. There are good arguments on both sides, but conclusive information on the subject can only be obtained from their breeding grounds in the far north.

Of Ducks I have noticed in the market and elsewhere, twenty different species, the gayest of which is the *Wood-duck*, so called from its habit of building its nest in the hollow of a decayed tree. A few pairs of this species annually raise their broods near the shores of the Dundas marsh; the *Teal* and the *Mallard* have also been observed leading out their young from the ready inlets of the Bay, but there are exceptional cases, as the great body pass farther to the north, paying us a short visit going and returning.*

* It has been remarked by fishermen and others, who have had occasion to be on the waters of the Bay during the summer months, that there are usually about a dozen ducks which keep together in a small flock, and do not seem to take any share in the duties of the breeding season. The flock is composed of both sexes, and frequently of different species. Various conjectures have been formed as to the cause of this singular conduct, but the

Nearly allied to the Ducks is the small family of *Mergansers*, which contains only three species* peculiar to the American continent, all of which are, at certain seasons of the year found round the shores of the bay. The birds of this class subsist chiefly by fishing, and have the bill compressed and deeply serrated, to enable them to hold their slippery prey. They are also furnished with a crest, the use of which has been a matter of conjecture among naturalists, one of whom suggests that the elongated feathers of the head being acted on by the water, serve to give precision to the blow when striking the fish, much in the same way as a feather acts on the shaft of an arrow. The most beautiful of this class is the hooded merganser, whose fine erectile crest extends from the bill right over to the hind head. With us this species is never abundant, but a few pairs are seen every spring as soon as the ice begins to shove from the sides of the bay. Their stay at this season is short, as they soon pass on to the north to breed; in the fall they again pay us a visit accompanied by their young, and follow their avocation round the bay till they are frozen out, when they move off to the south to spend the winter.

Two species of Tern visit the bay in spring, and during winter three species of Gull have been observed at the beach; of the latter class the most conspicuous is the Great Black-backed Gull, which arrives from the north at the approach of winter, and leaves again on the first appearance of spring. The word *Gull*, as applied to the human species is often used to denote dullness or stupidity, but such a meaning could not be suggested by the character of the birds to which it belongs, as there is not, among all our water-fowl, a more vigilant species than that which we have just referred to; it never comes within gun-shot, and the only specimen ever procured at the beach, met his death by following the example of an eagle in tasting a poisoned carcase, a few minutes after which, both were stretched dead upon the ice.

Lowest on the list as being least perfect in their organization, are the Grebes, a class of birds which frequent the borders of our smaller lakes and ponds, finding their sustenance chiefly in the shallow waters, which abound with water-plants. Three different species of this genus

probability is, that they are birds, which, from being wounded, or otherwise in ill health, have been unable to perform the journey northwards, and prefer spending the summer in retirement, joining their comrades on their return in the fall.

* The Smew, or White Nun, is mentioned in some works as an American bird, but its occurrence is very rare and considered accidental.

are found in the bay, all of which are known to the gunners by the somewhat suggestive name of "Helldiver." An examination of these birds shows the most wonderful adaptation to their peculiar mode of life. Their food being obtained entirely under water, and their nest being only a few inches above its level, they have little occasion to be on land. When surprised in that situation, they seem most helpless, their legs being placed so far aft, they are unable to keep the body in anything like a horizontal position, and so make poor progress in walking, but the moment they reach the water, they disappear under the surface, and are not again seen while the cause of alarm remains. The plumage of this species is of the most compact and silky texture, and is never penetrated by water while the bird is in life. The legs are placed far behind the centre of gravity, to give it greater power in swimming, and are much compressed so as to offer the least possible resistance to water, while the toes, in place of being connected with a web as in the duck, are each furnished with a separate membrane, which enables the bird to pass with ease and celerity through the tangled masses of water-plants, among which its favorite food is found. In some parts of the European continent the skin of the Grebe is much prized as trimming for ladies' dresses; and in olden time, when the fowling piece was a less perfect instrument than at present, considerable difficulty was found in supplying the demand, as the Grebe being a most expert diver, disappeared at the first flash of the gun, and was under water ere the shot could reach it. Since the invention of the percussion cap, however, they are more readily killed, and were any of our Hamilton ladies desirous of having a dozen or two of Grebes skins for trimmings, I have no doubt the birds would be forthcoming. At present there being no demand for the *skins*, and the *flesh* being unsuitable for the table, they are not much disturbed.

Of the three species alluded to, one is a winter visitor, the other two remain during summer and rear their young in the Dundas marsh and the reedy inlets of the bay. They are well protected with feathers, yet seem very sensitive to the cold, moving off to the south at the first touch of frost, returning again about the latter end of April.

I have thus alluded to only a few of our more remarkable birds. The total number of species observed in the near vicinity of the city, from May, 1856, to the present time, amounts to 206, each of which

has a separate and distinct history of its own, though in many cases it is very imperfectly known to us. If sportsmen and others who have opportunity of observing the birds in their native haunts could be induced to make notes of their observations, and communicate them to public bodies having the means of making them known, much new information would no doubt be gained, and we could with tolerable certainty ascertain the geographical distribution of many species, a point at present undetermined.

There are few places in Canada so well situated for making such observations as Hamilton, for besides being in the near vicinity of a large lake and extensive marshes, which are the favorite resort of the waterfowl, it is situated between two lakes, on a narrow neck of land, which is most probably the route chosen by a large proportion of our short-winged summer birds when migrating to and from their great nursery in the north. It would also add much to the interest taken in this branch of natural history if museums were formed, accessible to the public, and containing well-preserved specimens ot all the birds found in their particular districts. Good books of reference should also be in the libraries, so that those whose tastes tend in that way, might have the means of getting correct information on their favorite subjects, without incurring very great expense.

With such facilities at command, we might fairly expect, that many of our young men would be induced to devote a portion of their spare time to these healthful and elevating studies, as a pleasing relaxation from the more confining duties of the counting-house and the store; and by cultivating and extending the love of what is true and beautiful in nature, keep alive the better feelings of the heart which the cares of the world are too often allowed to overgrow.

ON THE DEVONIAN FOSSILS OF CANADA WEST.

BY E. BILLINGS, F.G.S.

(Continued from Vol. V. *page* 282.—No. XXVII. *May*, 1860.)

As the nomenclature of the important and widely-distributed genus *Athyris* is somewhat confused, it seems advisable to give, in this place, a short account of the leading points of its history. Professor McCoy was the first to separate the species, of which this genus is

composed, from *Terebratula*, *Atrypa*, *Spirifera*, and other genera to which they had been previously referred. His original description was published in the "Synopsis of the Carboniferous Fossils of Ireland," in 1844. From this work we shall make the following extracts:—

"The family *Delthyridæ* appears to be divided into the five following genera: 1. *Spirifera*, Sow., composed of those longitudinally-ribbed species, in which the hinge-line is equal to, or exceeds the width of the shell, the cardinal area with parallel sides, the cardinal teeth of the ventral valve (now called the dorsal valve) large, spirally rolled, and having a triangular foramen beneath the beak of the dorsal (ventral) valve. 2. *Martinia*, McCoy, or the smooth Spirifers, in which the hinge-line is less than the width of the shell, and the cardinal area triangular. 3. *Athyris*, McCoy, in which there is no vestige of either foramen, cardinal area, or hinge-line. This remarkable genus is frequently confounded with those shells usually named *Terebratula*, in the older rocks, but is distinguished by the large, spiral appendages, which are wanting in the other group. 4. *Brachythyris*, McCoy, in which we find the longitudinally-ribbed surface of *Spirifera*, united with the short hinge-line of *Martinia*. 5. *Orthis*, Dal., in which there are no spiral appendages, the hinge-line and striæ frequently spinose (as in *Leptæna*), and the cardinal area common to both valves, and its sides inclined towards each other at its angles; dorsal valve smallest."—Work cited, page 128.

On page 146 of the same work, he thus concisely describes the genus:—

"*Gen. Ch.*—Nearly orbicular, small; no cardinal area or hinge-line; spiral appendages very large, filling the greater part of the shell.

"This very interesting group possesses all the external characters of the *Terebratulidæ*, united to the internal structure of the Spirifers, to which latter family it truly belongs. Professor Phillips is the only author who has recognized the group: he forms of it his last division of the genus *Spirifera*, but gives no characters to distinguish it from *Terebratula*; the internal structure is, however, a sure guide."

The above descriptions include all the more comprehensive and important characters, or those which connect the species together into one group by general affinities pervading the whole. In this respect nothing more has been done for this genus since 1844, although several minor and highly interesting points of the internal arrangements, such as the complicated structure of the spires and the form of the muscular impressions, have been ascertained by other authors; (especially by Messrs. Davidson, Bouchard, and Suess.)

McCoy was under the impression that all of the species were desti-

tute of an aperture in the ventral valve, but it now turns out that many of them have a small circular perforation in the beak. Some are therefore disposed to reject the name *Athyris* (which means "without a door;" or, "deltidium," as Mr. Woodward construes it) altogether as inappropriate; and accordingly D'Orbigny, in 1847, re-described the genus under the name of *Spirigera*. His description is in substance the same as that of McCoy, but more in detail, and, with the additional character, that the ventral valve is truncated at the beak by a circular orifice.* This would exclude more than half the species that he placed in his genus; as all those which belong to the group typified by *A. tumida*, *A. Ceres*, *A. passer*, &c., have the beak entire. With respect to this part of the shell, therefore, D'Orbigny's definition is quite as defective as McCoy's.

In 1851, Professor Suess, of Vienna, proposed the name of *Merista* for some of these shells, but did not define his genus nor give the names of any species to be included in it.†

In 1852, McCoy, in the 2nd Fasciculus of the "British Palæozoic Fossils," page 196, re-defined *Athyris* as follows:—

"*Gen. Ch.*—Nearly orbicular or ovate, both valves convex; no cardinal area, foramen, or hinge-line; spiral appendages to beak of entering valve very large, nearly filling the shell; a strong mesial septum in the rostral part of entering valve; dental lamellæ moderate; tissue of shell apparently fibrous.

"One specimen [of *A. tumida*] shews the pallial and ovarian impressions to be thick, numerous, and dichotomising frequently from beak to margin."

Afterwards, in 1854, Suess objected to the term *Athyris* being applied to such species as *A. tumida*, on the ground that it was originally used to include *Spirigera concentrica*, *S. lamellosa*, and other similarly organized forms.‡ He therefore proposed to suppress *Athyris* altogether, substituting *Spirigera* for those with the beak perforate, and his own genus *Merista* for the others with entire beak, or mesial septum in the dorsal valve and a shoe-lifter process in the ventral. It is quite certain now, however, that some of those with a non-perforate beak have no shoe-lifter process, and cannot be included in *Merista*.

In Davidson's "Introduction, on the Classification of the Brachiopoda," *Spirigera* is retained for those with the beak perforate, and no

* *Paléontologie Française*, vol. iv. page 357.

† *Jahrbuch der K. K. Geologischen Reichanstalt, Vienna*, ii. pt. 4, pp. 150, 160. 1851.

‡ This is taken from a note by Mr. Davidson, on page 4 of the Appendix to his British Oolitic and Liasic Brachiopoda.

mesial septum in the dorsal valve, (type *S. concentrica,*) and *Athyris* for those of which *A. tumida* is the typical form. This is the most just arrangement of the difficulty that has yet been proposed, and has been adopted by F. Rœmer in the last edition of Bronn's "Lethæa Geognostica."

Mr. Woodward in the "Manual of the Mollusca," adopts *Athyris* in the wide sense as intended by McCoy, but admits *Merista* as a sub-genus for those with a shoe-lifter process.

In the New York Reports, the species of this genus, until within the last four or five years, have been placed in the genus *Atrypa.*

In the tenth annual report of the Regents of the University of the State of New York, published in 1857, Professor Hall describes six species from the Upper Silurian rocks, under the genus *Merista,* and one from the Hamilton group, under *Spirigera.* This latter, which he calls *Spirigera spiriferoides,* is considered by many authors to be identical with *S. concentrica.*

In the Geology of Iowa, dated 1858, he describes three species from the carboniferous rocks of the Western States, under *Athyris.* These appear to be perfectly congeneric with *S. concentrica,* or, *S. spiriferoides* as he calls it.

In the twelfth Annual Report of the Regents, dated 15th March, 1859, published October, 1859, he proposes a new generic name (*Camarium,*) for those with a shoe-lifter process. This genus is identical with *Merista.*

In the thirteenth Annual Report of the Regents, published January 1861, Professor Hall abandons his genus *Camarium,* finding it to be identical with *Merista,* and then for those shells which have *Athyris tumida* for the type he proposes a new name, *Meristella.*

Some of the European authors, such as Pictet and Sandberger, retain *Spirigera,* and in his recent highly instructive papers in the "Geologist," Mr. Davidson places all the species under *Athyris,* but says that sub-genera may be admitted provided they be founded on good and sufficient distinctive characters.

It is not necessary to extend this list of references to the opinions of palæontologists. Sufficient appears in the above to shew that the nomenclature of this genus is in a state of confusion. I think the best way of getting out of the difficulty, is to fall back upon the arrangement proposed by Mr. Davidson in his Introduction.

1. McCoy's several definitions should be construed literally or

according to his intended meaning, and confined to such species as have the beak imperforate, and usually a mesial septum in the dorsal valve. For these the name *Athyris* is perfectly proper and involve no contradiction whatever. The type of this group would be *Athyris tumida*, as given by Davidson in his Introduction.

2. D'Orbigny's definition also literally, and it would include all the species with perforated beaks which have *Spirigera concentrica* for the type. The mesial septum in the dorsal valve in this genus is either rudimentary or entirely absent.

3. the genus *Athyris* being limited as above, two sub-genera might be subtracted from it, that is to say, *Merista*—Suess, and *Nucleospira*—Hall.

According to Professor Hall's recent proposals, *Spirigera* must be suppressed, and *Athyris* made to take its place. This would leave the first of the above groups without a name, and thus his genus *Meristella* would be accommodated.

The following figures represent some of the internal characters of the above mentioned genera :

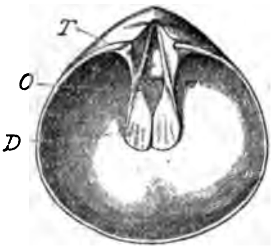

Fig. 48.

Fig. 49.

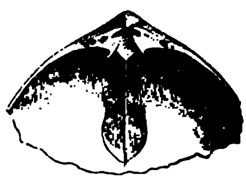

Fig. 50.

Fig. 48.—*Athyris tumida.*—Dalman.—Interior of ventral valve. *D.*—divaricator impressions *O.*—occlusor impressions. *T.*—teeth.
Fig. 49.—Interior of ventral valve of *Athyris Clara* —Billings.
Fig. 50 —*Athyris Clara*, interior of dorsal valve.

In the interior of the ventral valve of *A. tumida*, Fig. 48, the two elongate oval scars which indicate the place of the attachment of the divaricator muscles or those whose function it was to open the valves, are situated side by side about the centre of the shell. Above, or partly between, is the small heart-shaped scar of the occlusor, the muscle that served to close the valves. Beneath the beak is seen the wide triangular foramen which, in consequence of the close incurvation of the beak is always completely closed. This foramen is a different

thing from the small circular aperture which occurs in the point of the beak of *Spirigera*. On each side is a short stout tooth, beneath which a strong nearly vertical septum extends a short way towards the front. These two septa are the dental-plates. Fig. 49 shews the form of the muscular impressions in *A. Clara*. At first sight they appear to be widely different from those of *A. tumida*, but this is owing to the greater thickness of the shell in the upper half of the ventral valve of this species. Since this species was described in this Journal, in May last, I have ascertained that the same variations in the form of the muscular impressions occur in the genus *Spirifera*. In the thick-shelled species it is deeply excavated, and is represented on the cast of the interior by an abrupt prominence, longitudinally or diagonally striated.

In the thin-shelled species it is superficial, and presents a different appearance. There are other variations in the form of the scars in the ventral valve not represented in the above figures. Sometimes they extend nearly to the front of the shell, as is the case in an undescribed species from Anticosti, and in a Corniferous species of which I have some fragments.

In the dorsal valve, fig. 50, there is a horizontal plate (the hinge-plate) just beneath the beak, with a triangular depression in the middle, from which a thin vertical septum extends about one-half the length of the shell. On each side of the central depression the hinge-plate of the specimen figured shows two short, slender, spine-like projections, these are simply the bases of the spiral arms, which were here attached to the anterior edge of the plate. At the extremities of the hinge-plate are two small pits,—the sockets for the reception of the teeth of the opposite valve. The occlusor muscular impressions are four in number, and elongate oval, the anterior pair about the middle of the shell, and the posterior pair between the anterior and the beak.

Fig. 48 is copied from Mr. Davidson's paper in the "Geologist," Vol. I., Plate 12. Figs. 49 and 50 are from specimens in the collection of the Geological Survey.

In the sub-genus *Merista* the dental plates are connected by a peculiar arched plate, resembling a shoe-lifter, hence its name,—the shoe-lifter process or septum. (See fig. 53). In the species on which Prof. Hall founded his genus, *Camarium*, and also in some of the European forms, it extends from the beak downwards half the length

of the valve, and the dental plates are partly supported by it. I think this process is an abnormal form of the pseudo-deltidium, that occurs in some of the Spirifers.

In all of the genera, *Spirifera, Cyrtia, Spiriferina, Suessia, Cyrtina, Athyris, Spirigera, Merista, Nucleospira,* and *Uncites,* the spiral appendages have the apices of the cones which they form directed outwards, towards the sides of the shell, as represented in the following figure, 51.

Fig. 51.

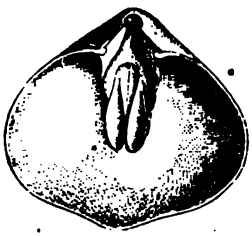

Fig. 52.

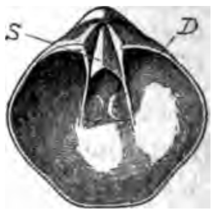

Fig. 53.

Fig. 51. Interior of *Athyris* (Spirigera) *ambigua*, showing the disposition of the spiral appendages. Copied from Davidson.—(*Geologist*, Vol, III. Plate 1.

Fig. 52. Interior of ventral valve of *Spirigera concentrica* shewing the muscular impressions and the circular aperture in the beak.

Fig. 53. Interior of ventral valve of *Merista Herculea* (Barrande), a Bohemian species, S.—the shoe-lifter process. D.—the divaricator muscular impressions.

It will be seen on examining fig. 51 closely, that the first coils of the spiral appendages are connected on the dorsal side by a transverse bar, from which an upright process springs, sloping upwards slightly towards the beak, and giving off two half coils,—one on each side. It

is yet to be ascertained in how many species this complicated structure prevails. We may expect to find by continued search in our Canadian rocks, specimens which will enable us to make out the structure of these peculiar organs in such species as we have. As yet, I have only seen five or six specimens of *A. Clara* and *A. Maia* in which the spires could be seen, but none are sufficiently perfect to exhibit the details.

In Mr. Davidson's earlier writings, the muscle called the "DIVARICATOR" in this article, is styled the "RETRACTOR," while the "OCCLUSOR" is designated the "ADDUCTOR." But in his recent papers in the *Geologist* he uses both. It appears that the new names, "Divaricator" and "Retractor," were devised by Mr. Hancock.

I shall hereafter, from time to time, as materials are collected, publish in this Journal such other particulars of the structure of these interesting genera as may seem to be of importance.

Of this genus, *Spirigera*, we have, as yet, clearly recognized only one species in Canada, but it is, in the opinion of some good palæontologists, identical with the famous *S. concentrica*, the type of the group. Three species, described in May last in this Journal, which have the beak perforated, may possibly belong to *Spirigera*, and would have been so referred, but at that time I had not made up my mind what course to take with regard to the sub-divisions of *Athyris*. The three species in question are not yet generically determined, and I have therefore marked them doubtful thus: *Athyris* (?) *scitula*, *Athyris* (?) *rostrata* and *Athyris* (?) *Chlöe*.

SPIRIGERA CONCENTRICA.—(Bronn, *Sp.*)

TEREBRATULA CONCENTRICA.—Bronn, 1829. ATRYPA + SPIRIGERA + ATHYRIS CONCENTRICA,—of the generality of authors. SPIRIGERA SPIRIFEROIDES, Hall.—*Tenth Annual Report of the Regents of the University of the State of New York*, p. 153. 1857.

Fig. 54.

Fig. 55.

Fig. 54. *Spirigera concentrica*—Dorsal view. Fig. 55. The same.—Ventral view.


Fig. 56.


Fig. 57.

Fig. 56.=Side view. Fig. 57.—Dorsal view of a specimen with a truncated front margin.

Description.—Transversely sub-oval; greatest width about the middle or a little above; the front margin sometimes extended into a short, broadly-rounded linguiform projection, and sometimes nearly straight, or even a little concave for about one-third the width. Both valves moderately convex; the ventral valve usually with a shallow mesial sinus, or depression, which becomes obsolete before reaching the beak; dorsal valve with a broad slightly elevated mesial fold. Beak and umbo of ventral valve of moderate size, the former incurved, and perforated at the point by a circular aperture. The umbo of the dorsal valve is small and neatly rounded, the beak buried beneath that of the opposite valve. Surface marked by sharp concentric ridges, which are sometimes so greatly developed as to cover the whole shell with thin overlapping scale-like plates.

Length from nine to fifteen lines; width a little greater than the length.

This well known fossil has a very wide geographical distribution, being found in the Devonian rocks of Russia, Germany, France, Spain, England, and America.

It varies a good deal in form, according to the sediment in which it is found. Where the shell is thin, the middle of the front margin is straight or concave, as in Fig. 57; but the thick-shelled individuals have the front margin more or less pointed. Some think our species different from the European form; but others, such as De Verneuil, Roemer, Lyell, Sharpe, and others, who have compared specimens from both sides of the Atlantic, have pronounced them to be identical.

Locality and formation.—Occurs in the Corniferous Limestone in the Township of Cayuga, and in the Hamilton Shales at various places in the Township of Bosanquet.

Collectors.—A. Murray, T. Richardson, J. De Cew.

Genus RETZIA.—(King.)

RETZIA.—King. *Monograph of the Permian Fossils of England,* p. 137. 1850.

RETZIA.—Woodward. *Manual of the Mollusca,* p. 224.

Generic characters.—The species of this genus are in general smaller than those of *Athyris* or *Spirigera.* The form is ovate or sub-globular; the ventral valve the largest, with an elevated beak, which is perforated at the tip by a small circular aperture; a small flat area beneath the beak. In some species there is a shallow mesial fold and sinus, or more usually two or three of the ribs in the middle smaller than the others. The surface is covered with radiating ribs, as in Rhynconella. The internal characters are not yet well known, but it is certain that the spiral appendages have their apices turned outwards, as in *Spirigera.* The shell structure is punctate.

Retzia differs from *Spirigera* in being strongly ribbed, smaller, the beak of the central valve erect, or nearly so, and in having a small flat area beneath the rostral aperture.

Rhynchospira,—Hall, does not appear to me to differ from *Retzia.* The genus is said to range from the Silurian up to the Permian.

Dedicated (by King) to the celebrated naturalist *Retzius.*

RETZIA EUGENIA.—*N. Sp.*

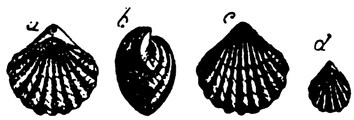

Fig. 58.

Fig. 58.—*Retzia Eugenia.* *a, b, c,* dorsal, side, and ventral views of a specimen; *d,* a smaller specimen—dorsal view.

Description.—Shell small, sub-globular, with from ten to twelve strong angular ribs on each valve. Ventral valve convex, most prominent on the upper half, a slight mesial depression the width of three or four of the ribs in the lower half; beak elevated, incurved, but not in contact with the umbo of the dorsal valve, perforated at the point; a flat, solid deltidium or area beneath the aperture. Dorsal valve rather strongly and uniformly convex, most prominent along the middle, where slight indications of a mesial fold are evident; umbo small, rounded; beak buried beneath the lower edge of the deltidium or area of the ventral valve.

Length of the largest specimen seen, six lines; width about the

same, or slightly less than the length; elevation of the beak of the ventral valve above the umbo of the dorsal valve, half a line.

We have one small specimen three lines in length, which appears to belong to this species. In form it is rather more elongate-oval, and not so convex as the larger specimens.

Closely allied to *Retzia globosa* (*Trematospira globosa*), Hall, but in that species when there are any indications of mesial fold or depression, it consists of one, two, or three ribs, which are smaller than the others, and do not reach the beak. It may be that specimens will be found connecting the two species, but at present I think it best to keep them separate.

Locality and Formation.—Lot No. 5, Con. 4, Township of Walpole.

Collector.—The only specimens I have seen were collected by J. De Cew.

(*To be continued.*)

NOTE ON A NEW GENUS OF PALÆOZOIC BRACHIOPODA.

BY E. BILLINGS, F.G.S.

Genus CHARIONELLA.—*N. G.*

Since the foregoing article on Devonian Fossils was written, I have ascertained the generic characters of the so-called *Atrypa* or *Athyris scitula*. It has internal spires with their apices directed outwards, as in *Athyris* and *Spirigera*, but the dorsal hinge-plate has its anterior margin and a large portion along the middle anchylosed to the bottom of the valve. In another congeneric species, the middle portion of the same plate is obsolete, there remaining only two small, thin, nearly vertical septa, (socket plates) one on each side of the cavity of the umbo. The perforation in the beak of the ventral valve is bounded on the lower side by a deltidium of either one or two pieces or by a portion of the shell. The mesial septum in the dorsal valve is either rudimentary or entirely absent.

The several species of this group, at present known to me, resemble *Athyris*, but are not so convex, and are, besides, more elongate ovate, or approaching to *Terebratula* in general form. I shall give further details and some figures in the next number of this Journal.

The genus is only proposed as a sub-group to be retained in case *Athyris* is divided.

A POPULAR EXPOSITION OF THE MINERALS AND GEOLOGY OF CANADA.

BY E. J. CHAPMAN,

PROFESSOR OF MINERALOGY AND GEOLOGY IN UNIVERSITY COLLEGE, TORONTO.

(*Continued from Vol. V., page 531.*)

The present article concludes the Second Part of this subject, completing our Synopsis of Canadian Minerals.

D. *Aspect Non-metallic (stony, glassy, etc.) Hardness insufficient to scratch glass**.

D. 1. *Soluble (sapid) minerals.*

To this group belong: Rock Salt, Sulphate of Iron or Green Vitriol, Sulphate of Copper or Blue Vitriol, Sulphate of Zinc, Alum, &c., none of which have yet been discovered, at least as solid minerals, in Canada. Rock Salt occurs elsewhere in lamellar masses and in cubes, either colourless or coloured brown, red, &c. It has a strongly saline taste, and is deliquescent. Green Vitriol occurs chiefly on decomposing iron-pyrites, in white or greenish crusts and acicular crystals. Blue Vitriol, as a bluish efflorescence or in crystalline groups on decomposing copper ores; and also in solution in mine waters, from which the copper may be precipitated on pieces of iron plate. Both yield a strong, metallic taste. An efflorescence of Epsom Salt, a substance easily recognized by its peculiar taste, has been noticed in certain serpentines from Marmora, C. W.

D. 2. *Taking fire when held in thin splinters in the flame of a candle.*

The minerals belonging to this group admit of a natural subdivision into two sections, according to the following arrangement:—§ 1. *Burning with blue flame and odour of Sulphur or of Garlic*:—Native Sulphur, (aspect, resinous; yellow, sp. gr. about 2·0); Orpiment, (golden or lemon-yellow, paler in the streak, sp. gr. 3·4–3·5); Realgar, (red, with orange-yellow streak); Cinnabar or sulphide of Mercury, (red, with red streak; sp. gr., in pure specimens, 8·0–8·2). Orpiment and Realgar are compounds of sulphur and arsenic, and yield, when burning, an alliaceous or garlic-like odour. § 2. *Burning with yellowish flame and bituminous or resinous odour*:—Amber, and also the various kinds of Bituminous Coal, including Jet, with Brown Coal or Lignite, and Bitumen or Asphaltum, may be placed in this section. Of these minerals, two only have been met with in Canada: (1.) A kind of indurated bitumen, occurring in small, black, and more or less friable masses, in crevices in the Trenton Limestone and other fossiliferous rocks, sometimes filling, indeed, the interior of fossil shells, and much resembling coal

* See the heads of this arrangement or classification at page 170 of Vol. V.

in its general aspect; and, (2.) A dark variety of Petroleum, becoming viscous and even solid on continued exposure to the atmosphere. This latter substance, which occurs abundantly in springs and wells traversing the Devonian beds of Inniskillen, Mosa, &c., of the western peninsula of Canada, and which has also been discovered in Gaspé, will be noticed fully in its geological relations, under PART V., of the present Essay. The bituminous and more or less inflammable shales of these Devonian beds, and those belonging to the Utica Slate subdivision of the Lower Silurian series, will come under review, also, in the same place.

D. 3. *Not exhibiting the reactions of D.* 1 *or D.* 2. *Streak coloured.*

Earthy Manganese Ore:—Black or Brown; in earthy masses, which usually soil the hands. Streak, chiefly dark-brown, sometimes black. Infusible, yielding water in the bulb-tube. When fused with carbonate of soda, it forms a "turquoise enamel," blue whilst hot, and green when cold. Composition very variable, but essentially: hydrated sesquioxyd of manganese. Earthy or Bog Manganese Ore, sometimes called "Wad," occurs in the Eastern Townships of Bolton and Stanstead; in Aubert-Gallion, Tring, and Ste. Marie, in Beauce County; and at Ste. Anne, in Canada East.

Scaly Iron Ore (A variety of *Red Iron Ore*):—In glistening, red masses, of a scaly or laminar structure; streak, red. Soils the hands, more or less. Becomes magnetic before the blow-pipe. This variety of Red Iron Ore occurs in small quantities at many of the localities in which the latter mineral is found. See A. 4, (vol. V. p. 173.) Some specimens have recently been sent to us from the back of Peterboro', Canada West.

Red Ochre (An earthy variety of *Red Iron Ore*):—Chiefly in amorphous masses of a dull red colour, with earthy aspect, red streak, and low degree of hardness; but sometimes occurring as a red powder. It leaves a red trace on paper. Blackens and becomes magnetic before the blow-pipe, or when held (in the form of a thin splinter) in the flame of a candle or ignited match. Red Ochre occurs at Point-du-Lac (St. Maurice County), St. Nicholas, Ste. Anne, and other localities in Eastern Canada, accompanying Bog Iron Ore and Yellow Ochre. With the latter, it is largely employed as a wash or paint for wood-work, and also in the preparation of various pigments.

Bog Iron Ore (A variety of *Brown Iron Ore*):—Chiefly in amorphous masses with sub-metallic aspect. Colour dark brown; streak, yellowish-brown. Gives off water in the bulb-tube, and

becomes magnetic after ignition. For more complete description, see A. 4, (Vol. V. p. 175.)

Yellow Ochre (An earthy variety of *Brown Iron Ore*) :—In amorphous and earthy masses of a dull yellow colour and streak. Leaves a yellow trace on paper; gives off water in the bulb-tube, and becomes magnetic after ignition. Localities and uses, the same as those of Red Ochre, described above. Of the two ochres, however, the present is by far the more abundant, and is the principal basis of the pigments manufactured at Point-du-Lac, in St. Maurice County. Quite recently it has been found, in some abundance, in the County of Middlesex, C. W.

Humboltine, (Oxalate of Iron):—In yellowish crusts or thin layers in the bituminous shales (Devonian) of Kettle Point, Lake Huron, and the township of Inniskillen, Canada West. Streka, pale yellow or greyish. Turns black and red before the blow-pipe, and becomes magnetic. Yields about 16 per cent. of water in the bulb-tube.

Uran-Ochre, (Hydrated Oxide of Uranium):—In small earthy masses of a yellow colour, accompanying actynolite in the magnetic iron-ore of Madoc, C. W. Blackens before the blow-pipe, but does not fuse.

Vivianite or *Phosphate of Iron*:—In blue pulverulent masses, associated with bog iron ore in Vaudreuil County, on the St. Lawrence and Ottawa, C. E. Composition: phosphoric acid, protoxide of iron, and about 28 per cent. of water.

Malachite or *Green Carbonate of Copper*:—Chiefly in green masses of a fibrous or lamellar structure, sometimes with botryoidal surface and banded shades of colour. Otherwise, in earthy coatings on copper ores, &c. Streak, pale green. H. 3·5—4·0 (or less); sp. gr. 3·7—4·0. Yields water in the bulb-tube, and becomes reduced *per se* to metallic copper before the blow-pipe, tinging the flame green. Composition: carbonic acid, 20; oxide of copper, 72; water 8—the latter, however, usually somewhat higher. Malachite occurs in small quantities, with native silver, &c., in quartz and calc-spar at Prince's Mine, Spar Island, Lake Superior. Also occasionally, as an incrustation, amongst the copper ores of Lake Huron and those of the Eastern Townships. The blue carbonate, in an earthy state, is sometimes mixed with it.

The following minerals may also be referred to, in connexion with this group:—*Red Copper Ore* (sub-oxide of copper.) Red, with red streak; often in octahedrons and rhombic dodecahedrons, converted on the surface into green malachite; fusible and reducible *per se*, colouring the flame green.—*Black Oxide of Copper.* Chiefly in black, earthy, or amorphous masses, (or cubical crystals) from the south shore of Lake Superior. Blowpipe characters like those of red copper ore.—*Red Zinc Ore.* In granular or lamellar masses of a red colour, with orange-yellow streak. Lustre inclining to semi-metallic. H. 4·0–4·5. Quite infusible. Hitherto found only in New Jersey. Normal composition: Oxygen 19·75, zinc 80·25; but sesquioxide of manganese, to the amount of 3 or 4 per cent., is present, also, in most specimens.

D 4. Streak, white. Anhydrous. Not yielding water in the bulb-tube.

The Canadian minerals of this group may be conveniently arranged in several sections, as follows: § 1. YIELDING TO THE NAIL: *Mica* of different kinds; certain varieties of *Talc; Asbestus.*—§ 2. EFFERVESCING STRONGLY IN COLD HYDROCHLORIC ACID: *Calcite* or *Calc Spar.*—§ 3. EFFERVESCING FEEBLY IN COLD, BUT SENSIBLY IN HOT ACID: *Dolomite, Magnesite.*—§ 4. FUSIBLE: *Fluor Spar* (phosphoresces); *Heavy Spar* (colours flame pale green); *Celestine* (colours flame red)—INFUSIBLE: Light-coloured varieties of *Zinc Blende.*

§ 1. YIELDING TO THE NAIL.

Mica.—The term "mica" includes properly, a series of distinct though closely allied silicates, presenting equally a metallic-pearly lustre and a strongly-marked foliaceous or fissile structure, the thin, component laminæ of which are flexible and elastic. These distinct species being, however, in many instances, of very difficult separation—frequently requiring indeed, for that purpose, the aid of accurate chemical analysis, and minute optical and crystallographic investigation—they may be grouped together in an Essay like the present, more especially with regard to their geological bearings, and treated practically as one species. Thus considered, mica occurs in foliated and scaly masses, and occasionally in six-sided and rhombic prisms, of a white, brown, black, grey, green, red, or yellow colour, with pseudo-metallic or pearly aspect. The prisms are often tabular, as in figure 46. H. 1·0 on the faces or broad surfaces of the laminæ, and sometimes as high as 5·0 on the edges. Cleavage very strongly marked in one direction, so that by means of the finger-nail, or the point of a knife, leaves of extreme tenuity may be obtained. These are flexible and elastic. Sp. gr. 2·7—3·1. Some varieties are fusible; others become opaque before the blowpipe, but

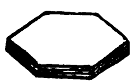

Fig. 46.

do not fuse. Common mica is essentially composed of silica, alumina, and potash; but other micas contain magnesia, oxides of iron, lithia, &c. Mica is a component of granite, of ordinary gneiss, mica slate, and other eruptive and metamorphic rocks, besides being of frequent occurrence in trachytes, lavas, &c. In Canada it occurs in more or less distinct specimens throughout the area occupied by our Laurentian rocks, and also in the metamorphic district of the Eastern Townships, both in the stratified-crystalline and in the trappean or trachytic rocks there present. In the crystalline limestone (Laurentian Series) of the township of Grenville, Argenteuil county, C.E., plates are obtained of sufficient size to be employed for stove-fronts, lanterns, &c. We possess some crystals of a yellowish-green colour, over half-an-inch in length, and perfectly translucent in a transverse direction or parallel with the cleavage-plane. They are imbedded in crystalline limestone and are said to have come from the Upper Ottawa. A lithia-containing mica, known as *Lepidolite*, in granular-scaly masses of a pink or reddish-grey colour, and pearly lustre, occurs in Maine, and elsewhere in the United States, but has not been found, as yet, in Canada. It fuses very easily and with continued bubbling, tinging the flame red.

Talc (certain varieties.)—In white or greenish foliated masses, somewhat unctuous to the touch, and yielding readily to the nail. Most varieties give off water when heated, and hence this mineral is described more fully under division *D* 5 below.

Asbestus.—In soft, fibrous, and more or less flexible masses, of a green, white, or other colour. Easily fusible. See under *Hornblende* and *Augite*, *C* 3, above. (Vol. V., p. 527.)

§ 2. Effervescing strongly in Cold Acids.

Calcite or Calc Spar.—Of all colours—white, grey, yellow, black, &c., with white streak. Occurs in lamellar, fibrous, and granular masses, in stalactites, &c., and in crystals of the hexagonal system, some of which are shewn in the accompanying figures. Cleavage strongly marked in three directions, producing a rhombohedron of 105° 5′ and 74° 55′,—fig. 47 *a*. H. 3·0; sp. gr. 2·5—2·75. Infusible, but glows strongly before the blowpipe, and becomes caustic. Soluble with effervescence in acids. Composition: carbonic acid 44, lime 56; but a small portion of the carbonate of lime is generally replaced by carbonate of iron or magnesia. This substance, in the form of rock

masses, (limestone, marble, &c.,) is perhaps the most abundantly distributed of all minerals, quartz only excepted. In Canada, in the crystalline limestones of the Laurentian Series, and in the vast calcareous deposits of the Huronian, Silurian, and Devonian formations, it occupies extended areas, although much concealed by the overlying clays and gravels of the Drift. Rhombohedrons, scalenohedrons, and other crystals are frequently met with in cracks and hollows in these limestone and other rocks.* Stalactitic masses are also found under similar conditions; and nodular concretions occur in the amygdaloidal traps of Lake Huron and Lake Superior. Fine crystallizations, also, amongst the copper deposits of these lakes. White and variously coloured marbles of much beauty are obtained from our Laurentian rocks and from the more modern metamorphic series, south of the St. Lawrence; but these, with the other economic limestones of Canada, will come under review in PART V. of this Essay. It should be observed, however, that many of our so-called limestones are dolomites or dolomitic limestones, containing magnesia. See under *Dolomite* below.

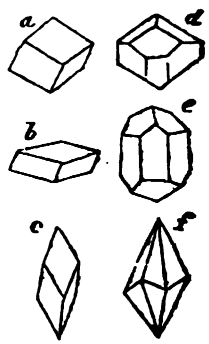

Fig. 47.

NOTE.—Carbonate of lime is a dimorphous substance, occurring under two distinct series of crystal-forms: the crystallographic difference being accompanied, moreover, by a difference of hardness and other physical characters. It thus forms two distinct minerals: *Calc spar* and *Arragonite*. Whilst the former, or normal condition of carbonate of lime, is exceedingly abundant, the latter is comparatively rare. Arragonite crystallises in rhombic prisms and other trimetric combinations (the compounds of which often present a pseudo-hexagonal aspect), and also in fibrous, coralloidal and botryoidal masses. Small splinters, when heated, become immediately opaque, and crumble or decrepitate gently into powder, a peculiarity by which this mineral may be distinguished from calc spar. Fibrous arragonite appears to occur sparingly amongst the Lake Superior traps and occasionally in thin coatings on the sides of cracks in some of our limestone rocks, but nowhere in very distinct specimens.

* Whilst writing this description, for example, we have received some large crystals (combinations of a rhombohedron and two scalenohedrons) from a cavity in the Trenton limestone (Lower Silurian Series) of Huntingdon township, in the county of Hastings, C.W. The cavity contained an immense number of these crystals.

§ 3. Effervescing in heated Hydrochloric Acid, but not at all, or only feebly, in cold acids.

Dolomite.—White, grey, brown, &c., in lamellar and granular masses, and in rhombohedrons, closely resembling calc spar. H. 3·5–4·0; sp. gr. 2·8–2·95. Infusible, but becoming caustic after ignition. Effervesces feebly in cold, but vigorously in heated acids. Composition: carbonic acid, lime, and magnesia; or, carbonate of lime 54·35, carbonate of magnesia 45·65; a certain portion of the lime and magnesia being, however, generally replaced by protoxide of iron or manganese. Dolomite occurs (in small groups of rhombohedrons) amongst the copper ores of Lake Huron, and also in fissures and cavities in many of our limestone rocks, as at Niagara Falls and elsewhere. Many of our so-called limestones indeed, consist, in themselves, of dolomite, pure, or nearly so. Those of Galt, Guelph, &c., in Canada West, may be cited as examples. Others are dolomitic limestones, or mixtures of limestone and dolomite. Very few are wholly destitute of magnesia. Crystalline dolomite and dolomitic limestone, again, exactly resembling the ordinary crystalline limestones, occur in beds amongst the gneissoid rocks of the Laurentian Series, as at Lake Mazinaw, &c. These rocks come properly under discussion in Part V.

Magnesite.—White, grey, &c., in granular-crystalline masses and in rhombohedrons, much like those of calc spar and dolomite.* H. 3·5–4·5; sp. gr. 2·8–3·0. Infusible, but becoming caustic after strong ignition. Composition: carbonic acid 52·5, magnesia 47.5; but most specimens contain a small amount of carbonate of iron, lime, &c. Magnesia does not efferverse in cold hydrochloric or nitric acid, and dissolves but slowly in these acids under the aid of heat. In Canada, this mineral occurs in beds amongst the altered Silurian strata of Bolton and Sutton townships, in Canada East. (See analyses by T. Sterry Hunt in the Geological Report for 1856.)

§ 4. Fusible.

Fluor Spar.—Chiefly in cubes, either simple, or modified on the edges and angles (Fig. 48, *a* to *c*). These cubical crystals break readily at the corners, owing to their strongly-pronounced octahedral

* In calc spar, the cleavage rhombohedron measures 105° 5′ over a polar edge; in dolomite, 106° 15′; and in magnesite 107° 29′. In carbonate of iron (a mineral also belonging, with carbonate of manganese, carbonate of zinc, &c., to the natural group of Rhombohedral Carbonates), the same angle equals 107°.

cleavage, and the regular octahedron (Fig 48 *d*) may thus be obtained from them. Specimens occur of all colours, but chiefly, dark violet-blue, lilac, yellow, green, white, and grey: the edges of the crystals being often of a deeper or lighter shade, or even of a different colour, from the central parts. Streak, white. H. 4·0; sp. gr. 3·1–3·2. Fusible before the blowpipe into a white enamel, but most specimens decrepitate on the first application of the flame. (See PART I., Vol. V., pp. 17–18). When crushed to a coarse powder and gently heated, a greenish or other coloured phosphorescence is usually exhibited. Composition: fluorine 48·7, calcium (the metallic base of lime) 51·3. Fluor spar occurs in some of the crystalline limestones of our Laurentian rocks; and here and there in the metalliferous veins of the Huronian formation; also, in small cavities in the limestones of the Silurian series. The best known localities comprise Fluor Island in Prince's Bay, on the north shore of Lake Superior, where fine green crystals occur; Iron Island on Lake Nipissing, where blue crystals were discovered by Mr. Murray*; the township of Ross in Renfrew County, on the Ottawa; the Niagara limestone about the Falls, &c. In Europe, fluor spar occurs, more especially, in association with lead, tin, and silver ores, in metallic veins.

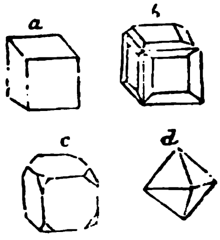

Fig. 48.

Heavy Spar or *Sulphate of Baryta.*—White, grey, yellow, reddish, etc., with white or uncoloured streak. In lamellar, laminar, and fibrous masses; and also in trimetric crystals, of which a common example is given in figure 49. H. 3·0–3·5; sp. gr. 4·3–4·7. Decrepitates (in general) before the blowpipe, (see PART I., Vol. V., p. 17–18), and fuses into a white enamel, tinging the point of the flame pale green. This latter character is well-marked, and serves to distinguish, very readily, small pieces of heavy spar from other minerals of a similar aspect. With carbonate of soda in the yellow flame, it forms an alkaline sulphide, which imparts, when moistened, a dark stain to

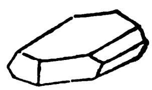
Fig. 49.

* See *Canadian Journal*, Vol. III, New Series, p. 325. Also Geological Report for 1854. The crystals occur in crevices and fissures of a cavernous limestone associated with specular iron ore.

silver.* Composition: sulphuric acid 34·33, baryta 65.67. This mineral occurs abundantly in many parts of Canada. In the Laurentian series of metamorphic strata, it forms considerable veins, usually accompanying galena: as in the townships of Lansdowne, Leeds Co., C. W.; Bathurst, Lanark Co.; McNab, Renfrew Co.; Dummer, Peterboro' Co.; and elsewhere. Red crystals were discovered by Mr. Murray on Iron Island, Lake Nipissing. It occurs likewise, in connection with the trap dykes of Lake Superior and the north shore of Lake Huron, as at Spar Island, &c., besides being found in some of the copper-ore veins of the Bruce mines. Heavy spar has also been met with in the serpentines and other rocks of the eastern metamorphic region, south of the St. Lawrence; and occasionally in cavities in the Niagara limestones of the west. It is employed somewhat largely in the manufacture of paints, and is too often used in this connection as a fraudulent substitute for white lead. Heavy spar is also the principal source of the baryta salts of the laboratory.

Celestine or *Sulphate of Strontia*:—White, grey, pale-blue, &c. In lamellar and fibrous masses, and in Trimetric crystals, often closely resembling those of Heavy Spar. A common combination is shewn in Figure 50. H. 3·0-3·5; sp. gr. 3·9–4·0. Before the blow-pipe, it (generally) decrepitates, fuses, and imparts a red coloration to the point of the flame. (See also the note under *Heavy Spar*.) Composition: sulphuric acid 43·6, strontia 54·4. Celestine occurs with small crystals of dolomite, gypsum, fluorspar, blende, and other minerals, in cavities of the Niagara limestone, as in the district around the Falls, and in the vicinity of Owen Sound, &c. Drummond's Island, Lake Huron, is likewise a noted locality of this mineral. It occurs also, occasionally, in crystalline limestone, as in the neighbourhood of Kingston. Celestine is the chief source of strontia salts, used in pyrotechny to

Fig. 50.

* To detect sulphur, in any form in mineral bodies, fuse a small quantity of the substance under examination, with carb. soda and a very little borax, on charcoal, in a good reducing flame. Detach the fused mass, moisten it, and place it on a piece of bright silver, or on lead test-paper. (A coin or glazed visiting-card may be substituted for the purpose.) If sulphur be present, a yellowish, brown, or black stain will result. See *Canadian Journal*, New Series, Vol. III., p. 217-18. Both sulphate of baryta and sulphate of strontia dissolve readily in carbonate of soda before the blowpipe, resembling, in this respect, alkaline sulphates. Sulphate of lime (with all lime salts) on the other hand, requires the addition of a little borax to promote solubility.

impart a red colour to rockets and signal lights, and for laboratory purposes.

§ 5. Infusible.

Zinc Blende (Sulphide of Zinc):—This mineral has been already described under sub-division *B* 3, (Vol. V. p. 182,) but it is mentioned again in this place, as some of the light-coloured varieties present a vitreo-resinous or other non-metallic lustre. These are chiefly light brown or yellow, with colourless or very pale-brown streak. H. 3·5–4·0. Infusible. Sometimes phosphorescent when rubbed or scratched. Small bright-yellow crystals and crystalline masses occur sparingly in cavities and fissures of the Niagara limestone in the vicinity of the Falls. For other localities, &c., see *B* 3, above.

D 5. *Streak, white. Yielding water in the bulb-tube.*

The minerals of this sub-division (many of which, however, are merely altered varieties of other species) may be conveniently grouped in three sections, as follows: § 1. Yielding traces only, or a very small amount of water: *Mica*, (some few varieties): *Talc*, (including *Steatite*); *Renselaerite*; *Diallage*. § 2. Yielding a considerable amount of water; slowly dissolved by borax before the blowpipe: *Serpentine*; *Chlorite*; *Loganite*; *Pholerite*. § 3. Yielding a large amount of water: readily dissolved by borax before the blowpipe, the bead, when saturated, becoming opaque: *Gypsum*.

Mica:—In foliated masses, &c., with pearly pseudo-metallic lustre. Normally, anhydrous,—but specimens occasionally yield a little water when heated in the bulb-tube. See sub-division *D* 4 (§ 1) above.

Talc; (including *Steatite*):—Greenish-white, green, greyish, &c. In foliated, and also in compact masses, which feel more or less greasy, and which yield to the nail; sp. gr. 2·55–2·8. Very sectile. Flexible in thin foliæ, but not elastic. Infusible. Composition: silica 62, magnesia 33, water 5. Talc occurs in the form of talcose slate, in foliated masses, and more especially in the form of steatite or compact talc, principally amongst the metamorphic rocks of the more modern series, south of the St. Lawrence. Under the latter condition, or that of steatite, it forms extensive beds in the townships of Potton, Sutton, Bolton, Stanstead, Leeds, Ireland, Broughton, &c., throughout this region. It occurs also, though far less abundantly, amongst the older metamorphic rocks of the Laurentian series, as in the townships of Marmora, Elzevir, &c., in Canada

West. It is used as a fire-brick or refractory stone, and also as a coarse paint or wash.

Rensselaerite (a variety of *Steatite*, or *Altered Augite*) :—Greenish-white, brownish, &c.; in granular and compact masses much resembling steatite, and in pseudo morphous crystals after augite. H. 2·5–4·0; sp. gr. about 2·7–2·8. Very sectile. Lustre, somewhat waxy. Infusible, yielding about 4 or 5 per cent. of water in the bulb-tube. Composition : silica, magnesia, and water. Renselaerite cannot be regarded as a distinct mineral species. The crystals are evidently augite pseudomorphs, and the substance agrees essentially in composition with steatite. It occurs in beds associated with the crystalline limestones of the Laurentian rocks, as in the township of Grenville, Argenteuil County, C. E. Also in the townships of Ramsey, Rawdon and Lansdown. In Grenville, it contains (in fissures) a soft, yellowish-white, and earthy variety of serpentine (— *aphrodite*.)

Diallage :—This substance is generally regarded as a variety of Augite. (See *C* 3, above. Vol. V. p. 527.) Normally, it is anhydrous; but it is frequently more or less altered, and contains 3 or 4 per cent. of water. It forms lamellar or foliated masses, chiefly of a green or greenish-grey colour. H., sometimes, 5·0, but usually rather less; sp. gr. 3·0 to 3·1. Fusible into a greyish slag, though not easily. Canadian specimens give off a little water in the bulb-tube, and become in general red or reddish-brown. A variety from the township of Oxford, analysed by Mr. Sterry Hunt, contained: silica 47·20, magnesia 24·53, protoxide of iron 8·91, alumina 3·40, lime 11·36, water 5·80; with traces of the oxides of nickel and chromium. Occurs chiefly in the altered strata of the Eastern Townships, as in Oxford, Ham, and elsewhere, associated with serpentine, chromic iron ore, &c.

§ 2. Yielding a considerable quantity of Water in the bulb-tube. Slowly soluble in borax before the blowpipe.

Serpentine, (including *Retinalite*, *Picrolite*, *Chrysotile*, *&c.*) :—This substance occurs chiefly in amorphous or rock masses of a green, red, brown, bluish-grey, yellowish, or other colour, frequently veined or mottled. Also, occasionally, in small granular and fibrous masses, the latter sometimes producing a *serpentine-asbestus*. Lustre, usually somewhat waxy. H, in general, about 3·0; sometimes 4·0–5·0. Very sectile, sp. gr. 2·2–2·6. Some of the fibrous varieties fuse on the edges, the others are infusible. All yield water (and harden) in the bulb-tube. Composition, essentially: silica,

magnesia, and about 12 to 15 per cent. of water. Serpentine occurs in association with the crystalline limestones of the Laurentian rocks, as in the township of Grenville, Argenteuil county, C.E., where it occurs in disseminated grains; Calumet Island on the Ottawa; the township of Burgess, Lanark County, C.W.; Marmora and adjacent townships, with magnetic iron ore; and in other places where these rocks prevail. It is met with, however, far more extensively amongst the altered Silurian strata of the Eastern Townships, both alone, and forming, in some localities, especially in the townships of Oxford and Broughton, serpentine marbles of great beauty. Fine varieties of green serpentine occur about Brompton lake, in the former of these townships. A tough, fibrous variety occurs in Bolton township, Brome County. In Bolton and Ham also, serpentine rock, carrying thin beds of chromic iron ore, is met with; and in the county of Beauce, this rock contains a bed of mixed magnetic and titaniferous ore, fifty feet in thickness. To these localities must be added Mount Albert in Gaspé, where, as described by Mr. Richardson of the Geological Survey of Canada, an inexhaustible supply of green, brown, and variously striped and mottled serpentine, capable of economic employment, occurs in association with chromic iron. In its rock relations, serpentine will be discussed more fully in a succeeding part of this Essay.

Chlorite.—This mineral occurs chiefly in foliated, scaly, and granular masses of a dark green colour; or in greenish-grey slaty beds, forming the so-called *potstone*, a name also sometimes applied to varieties of steatite. H. 2·0—2·5; sectile; sp. gr. 2·6—2·8. Fusible (or fusible on the edges only, in some varieties,) and yielding water in the bulb-tube. Composition, essentially: silica 32·5, alumina 18·5, magnesia 36, water 13: hence, the chloritic potstones differ from the workable steatites in containing alumina as an essential constituent. In union with quartz, forming chlorite slate, this mineral is of common occurrence amongst metamorphic strata. In Canada, it occurs chiefly in the altered rocks of the Eastern townships, associated with magnetic and specular iron ores, sphene, &c., and with beds of dolomite. In this region, as in the townships of Potton, Bolton, &c., it is met with also in thick beds of a slaty or more or less compact structure, forming an aluminous potstone of good workable quality. Chloritic schists, probably of Huronian age, occur likewise, according to Sir William Logan, in great force in the valley of Lake Temisca-

ming, within the northern geological-basin of Canada. (See Part V. of this Essay.)

Loganite.—This substance named by Mr. Sterry Hunt, in honour of the Director of the Geological Survey of Canada, is a very doubtful species. It occurs in sub-resinous brownish masses, and in apparently pseudomorphous crystals (after Hornblende? Dana,) in the crystalline limestone of Calumet Island on the Ottawa. H, 3·0; sp. gr. about 2·6. Composition, according to the analysis of T. Sterry Hunt: Silica 32·49, alumina 18·18, sesqui-oxide of iron 2·14, magnesia 35·77, lime 0·95, water (and carbonic acid) 16·92. Dana places it under Pyrosclerite, a mineral closely related to Chlorite, if, indeed, truly separable from that species.

Pholerite.—The substance thus named, is usually looked upon as a product of alteration, arising from the decomposition of one of the feldspar species, (see *C.* 3, above: Vol. v. p. 528–9,) or, more directly, from the alteration of clay-slate. Under this view, it is a kind of *Kaolin*, with which substance it agrees in general composition. It presents, however, peculiar physical characters, much resembling those of talc, a mineral with which it is often confounded. Pholerite occurs in soft, unctuous, and scaly masses of a pearly aspect, and of a white or pale greenish or yellowish colour. Sp. gr. 2·3—2·6. Before the blowpipe, it exfoliates and curls up, but remains infusible. It consists essentially, of silica, alumina, and water: the latter varying from 13 to 15 per cent. Nacreous scales of this mineral occur, in fissures, in sandstone strata of Silurian age, near the Chaudière Falls in Canada East; and many of the altered slates of the adjoining metamorphic region appear to owe their talcose aspect to its presence, or to that of closely related non-magnesian silicates of more or less indefinite composition.

§ 3. Yielding a large amount of water. Readily dissolved by borax before the blowpipe: the bead, when saturated, becoming opaque.*

Gypsum.—(Hydrous Sulphate of lime.)—This important mineral occurs chiefly in lamellar, fibrous, and granular masses, of a white, grey, yellowish, or other colour, and also in crystals of the Monoclinic System, a common example of which is shown in the margin: fig. 50. Lustre often pearly. H=1·5—2·0, (and thus, all specimens of gypsum may be scratched by the nail,) Sp. gr. 2.25—2·35. Sectile; and, in thin lamellæ, somewhat flexible. Yields a large quantity of water in the bulb-tube; becomes opaque in the flame of a candle; and exfoliates and fuses before the blowpipe, into a white enamel. Composition: sulphuric acid 46·51, lime 32·56, water 20·93. The

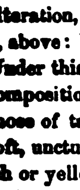

Fig. 50.

* The same result is produced with a moderate amount of the assay substance, when the bead is exposed to the action of an intermittent flame: a process technically termed "flaming."

transparent cleavable varieties are often called "selenite," and the fibrous and fine granular varieties are known by lapidaries as "satin spar," and "alabaster,"—names, however, sometimes applied to varieties of calc spar. Gypsum, when deprived of its water by a low heat, forms the well known *plaster of Paris*. In Western Canada, this most useful mineral occurs abundantly in the Gypsiferous or Onondaga Salt Group of the Upper Silurian Series (see Part V. of this Essay): as in the townships of Dumfries, Brantford, Oneida, Seneca, and Cayuga, more especially, along the valley of the Grand River. The gypsum does not occur in beds, properly so-called, but in vast irregular masses, supposed by Mr. Sterry Hunt, (*Comptes Rendus*, 1855, and *Esquisse géologique du Canada*,) to arise from the action, on the surrounding limestone strata, of springs containing free sulphuric acid. In these localities the gypsum is more or less mixed with carbonate of lime. Fibrous and other varieties occur also in the vicinity of Owen Sound, and throughout the tract of country, generally, between the eastern extremity of Lake Erie and the mouth of the Saugeen. Likewise, here and there, in small cavities and fissures in the Niagara limestone and older rocks.

APPENDIX.

A Classified List of the Canadian Minerals described above.

In this list, which is intended to serve as a kind of Index to the minerals described in the present Part of our Essay, each substance will be found arranged under the chemical sub-division to which it belongs. The letters and numerals within brackets, refer to the groups and sub-groups of the Arrangement adopted above.

1. *Simple Substances.*

Native Gold, (*B.* 1.) Native Platinum and Osmium-Iridium, (*B.* 1.) Native Silver, (*B.* 1.) Native Copper, (*B.* 1.) Graphite, (*B.* 2.)

2. *Arsenides* and *Sulphides*, (Combinations of arsenic, or sulphur, with metallic bases.)

Arsenical Nickel, (*A.* 2.) Sulphide of Silver, (*B.* 1.) Galena or Sulphide of lead, (*B.* 3.) Sulphide of Copper, (*B.* 3.) Purple Copper Pyrites, (*B.* 3.) Copper Pyrites, (*B.* 3.) Zinc Blende,

(*B*. 3, and *D*. 4.) Molybdenite, (*B*. 2.) Magnetic Pyrites, (*B*. 3.) Iron Pyrites, (*A*. 1.) Arsenical Pyrites, (*A*. 3.)

3. *Oxides of Iron, Manganese, &c.*

Specular or Red Iron Ore, (*A* 4, and *D* 3.) Ilmenite (*A* 4.) Brown Iron Ore (*A* 4, and *D* 3.) Magnetic Iron Ore (*A* 4, and *C* 1.) Iserine (*A* 4.) Chromic Iron Ore (*A* 4, and *C* 1.) Earthy Manganese Ore (*D* 3.) Uran Ochre (*D* 3.)

4. *Alumina* and *Aluminates*.

Corundum (*C* 1.) Spinel (*C* 1.)

5. *Silica* and *Silicates**.

Quartz (*C* 1.) Zircon (*C* 1.) Andalusite (*C* 1.) Cyanite (*C* 1.) Staurolite (*C* 1.) Garnet (*C* 3.) Idocrase (*C* 3.) Epidote (*C* 3.) Mica (*D* 4.) Tourmaline (*C* 3.) Chondrodite (*C* 2.) Olivine (*C* 2.) Hornblende, Actynolite, Tremolite (*C* 3.) Augite, Diopside, Asbestus (*C* 3, and *D* 4.) Hypersthene, Bronzite (*C* 3.) Diallage (*C* 3, and *D* 5.) Wollastonite or Tabular Spar (*C* 3.) Talc (*D* 5.) [Renselaerite (*D* 5.)] Serpentine (*D* 5.) Chlorite (*D* 5.) [Loganite (*D* 5.)] Orthoclase or Potash Feldspar (*C* 3.) [Pholerite, Kaolin (*D* 5.)] Albite (*C* 3.) Labradorite (*C* 3.) Scapolite or Wernerite (*C* 3.) Prehnite (*C* 4.) Datolite (*C* 4.) Thomsonite (*C* 4.) Analcime (*C* 4.) Apophyllite (*C* 4.)

6. *Titanic acid and Titaniates.*

Rutile (*C* 1.) Sphene (*C* 3): usually regarded as a silico-titaniate of lime, but its true atomic constitution is still uncertain.

7. *Carbonates.*

Calcite or Calc Spar (*D* 4.) Dolomite (*D* 4.) Magnesite (*D* 4.) Arragonite (*D* 4.) Malachite and Blue Carbonate of Copper (*D* 3.)

8. *Sulphates.*

Barytine or Heavy Spar (*D* 4.) Celestine or Sulphate of Strontia (*D* 4.) Gypsum (*D* 5.) Epsom Salt (*D* 1.)

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* Keeping in view the popular and explanatory character of this Essay, it may not be inappropriate to observe that the term "Silicate" signifies a combination of silica or silicic acid with one or more oxidized bases, such as a lime, magnesia, oxide of iron, alumina, &c. In like manner (to cite a few more examples of this nomenclature,) a "carbonate" is a combination of carbonic acid,—a "phosphate," of phosphoric acid,—a "sulphate," of sulphuric acid—with one or several of these oxides. Thus, *Gypsum*, consisting of sulphuric acid, lime, and water, is a hydrous sulphate of lime. The term "sulphide," or "sulphuret on the other hand, denotes a compound of sulphur with some simple substance, as lead, copper, iron, &c., or with several of these.

9. *Phosphates.*

Apatite or Phosphate of Lime (*C* 2.) Vivianite (*D* 3.)

10. *Fluorides.*

Fluor Spar (*D* 4.)

11 *Salts of Organic Origin.*

Humboldtine (*D* 3.)

12 *Bituminous substances.*

Asphaltum and Indurated Bitumen (*D* 2.)

CONCLUDING NOTE TO PART II.

The minerals of Canadian occurrence—including both the very rare and the doubtful species, such as native Platinum, occasionally found in small grains with the Native Gold of the Rivière du Loup; and the altered substances, Renselaerite Pholerite, &c.,—amount in number to about seventy. Many of these are of more or less local occurrence, but others, on the contrary, are comparatively common. These latter are collected together, and arranged in accordance with their more obvious characters, in the Table annexed to this Note. The less experienced reader, consequently, may avoid some trouble in the determination of an unknown mineral, by consulting this Table in the first instance. If the specimen under examination do not agree with the species here cited, the regular Table given at page 170 of Vol. V., can then be referred to. In case of agreement also, recourse may be had to the latter as a confirmatory test.

CANADIAN MINERALS OF MORE COMMON OCCURRENCE.

* *Aspect Metallic or Sub-Metallic.*

** *Hard enough to scratch glass.*

Brass-yellow :—*Iron Pyrites* (*A* 1.)

Steel-grey; powder, reddish :—*Specular Iron Ore* (*A* 4.)

Iron-black; powder, black; magnetic :—*Magnetic Iron Ore* (*A* 4.)

*** *Too soft to scratch glass*:

Bronze-yellow; slightly magnetic :—*Magnetic Pyrites* (*B* 3.)

Brass-yellow; streak, greenish-black :—*Copper Pyrites* (*B* 3.)

Reddish, with blue tarnish; streak, greyish-black :—*Purple Copper Pyrites* (*B* 3.)

Lead-grey; breaking into rectangular fragments :—*Galena* (*B* 3.)

Lead-grey; in soft scales; marking :—*Molybdenite* (*B* 2.)

Black; in soft scales; marking :—*Graphite* (*B* 2.)

Lustre, metallic-pearly; brown, silvery-white, etc.; in scales or foliated masses with white streak :—*Mica* (*D* 4.)

† *Aspect, vitreous, stony, or earthy.*

†† *Hard enough to scratch glass.*

Colourless. amethystine, red, &c.; No lamellar structure. Infusible:—*Quartz* (*C* 1.)

White, red, green, &c.; Lamellar structure. Fusible on the edges:—*Feldspar* (Orthoclase *C* 3.)

Dark-red; in 12-sided crystals, &c. Fusible:—*Garnet* (*C* 3.)

Black; fibrous, or in triangular crystals. Fusible:—*Schorl* (*C* 3.)

Black or green, (sometimes colourless in crystalline limestone.) Fusible: —*Hornblende* and *Augite* (*C* 3.)

††† *Too soft to scratch glass.*

White, grey, &c. Effervescing strongly in acids:—*Calc Spar* (*D* 4.)

White, grey, brownish, &c. Effervescing feebly in acids:—*Dolomite* (*D* 4.)

White, blueish, &c. Fusible. Often accompanying Galena:—*Heavy Spar* (*D* 4.)

White, greenish, mottled, &c. Very soft. Infusible. Yielding water in bulb-tube:—*Steatite* (*D* 5.) Also *Serpentine* (*D* 5.)

White, &c. Very soft. Fusible. Yielding water in bulb-tube:—*Gypsum* (*D* 5.)

Brown. Streak, yellowish-brown. Magnetic after exposure to heat:—*Bog Iron Ore* (*D* 8.) Also *Yellow Ochre* (*D* 8.)

Red. Streak, red. Magnetic after ignition:—*Red Ochre* and *Scaly Iron Ore* (*D* 8.)

SPECIMEN OF A FLORA OF CANADA, WITH PRELIMINARY REMARKS.

BY WILLIAM HINCKS, F.L.S., F.R.S.E.

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Flora is the name appropriated since Linnæus's time to a descriptive catalogue of the vegetable productions of any particular country, prepared in such a manner as to assist a student in acquiring a knowledge of the plants he may meet with. Where a country is separated from others by strongly marked natural boundaries, its flora often presents characteristic features of much interest in respect to the general distribution of plants. I need not say that this is not the case with Canada—the North American continent exhibiting in its flora

many common characteristics modified by latitude and local circumstances. It has been found a convenience by the students of Canadian Botany that the floras of the neighbouring United States, where there has earlier been a demand for such works, contain nearly all our plants, and consequently offer us much of the assistance that we need; but at the same time besides the not unnatural feeling of a desire as a nation to provide for our own scientific wants, the large number of plants found in the middle United States, which our more northern climate refuses to support, increases the catalogue to an extent which very materially adds to the difficulties of the student, and if no more were attempted than to exclude from the list, plants which we can have no expectation of finding within our borders, the utility of a Canadian Flora to those amongst us who desire to be acquainted with our native plants would not be small. My attention having been directed to the subject with this view, I have carefully considered in what respect I should be disposed to deviate from the methods which I find adopted by others, and I propose now very concisely to explain and defend my views, which I shall also illustrate by a sufficient specimen.

I would speak first of the system which it seems expedient to follow. I presume it would be needless to argue in favour of some modification of the natural method, and this being admitted, it will be found that, excepting in a few cases where sub-divisions are deemed necessary by some and rejected by others, there is general agreement as to the *orders* of plants. The differences, excepting where they have to do with the limits of genera and species, relate to the larger combinations, and to the most proper series, subjects manifestly of very inferior importance, and of such a nature that any one who has an ordinary acquaintance with the principles of the Science, could employ with facility any of the methods which have been recently proposed. The method of De Candolle, from its real merits and the deservedly high reputation of its author, as well as from its having been employed in his celebrated work, (*Prodromus Systematis Naturalis regni Vegetabilis,*) the greatest attempt in modern times at a general description of the species of plants, has obtained more currency than any other, and for that reason is apt to meet with favour. It seems to me, however, that the trifling inconvenience of making a change to those who are habituated to a particular arrangement, should by no means prevent our aiming at improvement, and having come to the conclusion that

on the whole the method of Lindley, (our greatest English authority in respect to Botanical classification,) is to be preferred; and especially that his attempt to characterize *alliances* or more extended groups, as well as Orders, is a great assistance to an intelligent student; I have made use of this method, undertaking on my own part to construct a series of tables, of a kind, which I have long found advantageous, to facilitate its application. In the names of the Orders I have uniformly followed Lindley, discarding such names, however familiar or expressive, as Cruciferæ, Leguminosæ, Umbelliferæ, Compositæ, and adopting the names ending in *aceæ* formed from some well-known characteristic genus. I confess to some unwillingness to give up the above mentioned names, but the advantages of a uniform system are in my estimation too great to be neglected, and require the sacrifice of mere habit and prejudice.

In giving the characters, I have been very particular about the language employed, discarding all such terms, however sanctioned by good recent authorities, as imply notions of structure which are now known to be erroneous. For example: the term *monopetalous* is avoided, as implying that the Corolla to which it is attributed really consists of a single petal, whilst it is now universally understood to arise from the coherence by their edges of several petals, which are really distinct organs. De Candolle's term *Gamopetalous* not seeming to be approved, I have used *Sympetalous*, and instead of *Poly-petalous*, *dialypetalous*, which very clearly and simply convey the right idea.

On a similar principle I object strongly to the term *pistil*, which I think should now only be used in its Linnæan sense and in connection with the Linnæan Artificial System. The inner part of the flower which becomes the fruit, (the Gynœcium,) is now well understood to consist of a certain number, one or more, leafy organs modified in their development, so as to be germ-producing, and furnished with a stigma—each of these is a carpel (carpellum.) The differences of structure consist in the number of carpels—one, some part of a complete circle, or the whole of it, or several circles—distinctly arranged or indefinitely crowded, with the carpels distinct or coherent, and if the latter, uniting together in several modes and degrees—with, or without the adherence upon them of the torus only, or of the calyx as well as the torus, with several modifications as to substance, membranous, coriaceous, woody, fleshy, or pulpy—and consequent differences in the mode of freeing the ripe seeds. These are the

differences which claim attention, and they cannot be expressed without a correct phraseology with which the use of the old term pistil is entirely inconsistent—nor do I believe that the use of terms correctly expressing our meaning can create difficulty to any one having even a slight acquaintance with vegetable organography.

It appears to me that accuracy in these matters is of real importance and that we cannot expect right notions to be formed in the minds of learners, whilst we cling to a terminology founded upon mistakes, now generally abandoned.

In order to make the study of our native plants a source of as much information as possible, I have in all important cases said something of the extent, properties and distribution of the order; I have given the number of known species in the genus from the best accessible authority, and I have stated respecting each species in what other parts of the world it is known to be found. As far as I could satisfy myself upon the subject I have distinguished between our genuine natives and introduced plants, and I have added notices of a few cultivated species, distinguishing them by a different type. I have formed my list of native plants from my own observations during six years, aided by several published catalogues, by the kind communications of several friends, and by such published authorities as I could consult, but I have thought it best to place in my list species known to be found in the Northern United States, and which might probably be expected in Canada, though I do not know of their having been found here.

The omission of any station or authority will sufficiently distinguish these doubtful natives to which I have also attached a note of interrogation.

I now lay before the Canadian Institute a specimen sufficient to illustrate my plan, including as many of the tables as are required to show their nature and use, and one small section of the work in its complete state. I have spoken of adopting the system of Lindley referring to my preference of it for practical use to that of De Candolle, but I must not seem to make that distinguished Botanist responsible for some changes which have seemed to me desirable, and which I can only submit to the candid judgment of those who study the subject.

(*To be continued.*)

REVIEWS.

Contributions to the Natural History of the United States of America. By Louis Agassiz. Second Monograph, in five parts:—I. Acalehps in general; II. Ctenophoræ; III. Discophoræ; IV. Hydroidæ; V. Homologies of the Radiata: With forty-six plates. Vol. III. Boston: Little, Brown and Co. London: Trübner, and Co. 1860.

Every lover of nature will watch with interest the progress of this great work and feel grateful to its illustrious author for opening his stores of curious and valuable information, which it has required genius, enthusiasm, indomitable industry, and long experience to bring together, apply and make available as he has done. The second monograph, of which the first volume is now before us, relates to the Acalephæ, sea-nettles or jelly-fish, a class of the Radiata branch, or sub-kingdom of the Animal Kingdom, to which it appears that the author has devoted much attention, and which, consisting chiefly of marine animals difficult to preserve and rarely seen in museums, is less known to persons of general information and even to many intelligent naturalists, than almost any other that could be named. Information respecting it founded on an intimate acquaintance with all that has been done by others, joined with most important original observations, applied in a truly philosophic spirit, must be proportionably acceptable.

After an historical introduction referring to all that has been done on the subject from the earliest time to the present day, our author proceeds to the determination of the natural limits of the class, and thence of the sub-kingdom or branch of the Animal Kingdom to which it belongs, examining the question whether the so-called Cœlenterata are really separable from the Echinodermata as a distinct branch. He decides this question on evidence satisfactory to us, setting aside the sub-kingdom Cœlenterata and establishing three classes of Radiata: Echinodermata, Acalephæ, and Polypifera, but proposing some changes in the limits of the two last-mentioned classes which deserve attention and have much probability in their favour.

It is a highly interesting and curious discovery of recent times that whilst certain Acalephæ in their early stages of development, assume the Polype form, the lowest division, as they were believed to be, of Polypes called Hydroids, most of them are found to produce

from what are called their ovarian vesicles, what seem to be true medusæ whether free or fixed. This remarkable observation caused some embarassment to speculative naturalists in determining the true gradation of animal forms. Since if Polypiferæ be the lower class it is credible enough that the early stages of development of Acalephæ, the next class in order, should bear a resemblance to Polypes, and *vice-versa*, but that two neighbouring classes should each in the young state assume the form of the other is antecedently improbable and is difficult to reconcile with our ideas of the order of nature. Our author proposes a novel view which completely relieves us from this difficulty, but which yet is not recommended to us for that purpose, but is supported by facts and by arguments of great weight, claiming careful consideration, and which we must say come near to convincing our minds. He maintains that Hydroid Polypes are imperfectly developed, or at least merely nutrient forms of the lower Acalephæ. He shows that the anomalous forms of Acalephæ are truly, in accordance with some of the most probable recent speculations, compound animals; that the floating colony contains Polype or nutrient forms along with medusan, which are reproductive forms, and he considers the Hydroid polypes as sedentary colonies of analogous character, either producing free medusæ, which are the perfect and properly reproductive form of the animal, or having as a part of the colony fixed medusæ forms, which fulfil the same function. Hence he transfers the Hydroid polypes altogether to the class Acalephæ, where with the other inferior and often compound animals of that class they make the lowest order *Hydroidæ*. Two other orders are recognized: the *Discophoræ*, or typical medusæ, and the *Ctenophoræ*, which are to be regarded as highest in the class.

It is a recognised principle that the presence of the polype form does not necessarily imply connection with the class Polypifera, as besides embryonic conditions of Acalephæ we have the Polyzoa of much higher organization, and the Vorticellidæ belonging to a lower type, both simulating the Polypes. Mr. Dana had already marked the great importance of the structural difference between the Hydroid and Actinoid Polypes. It remained for Agassiz, by determining the real characteristics of Polypifera, and the true interpretation of the medusa forms produced by the Hydroids, to settle, we may at least say with the highest probability, the proper limits of the classes, giving the Hydroids their place among Acalephæ.

The second chapter on Morphology and nomenclature among the Radiates contributes not a little to clearness of ideas, the correct perception of homologies, and the removal of popular errors in respect to this branch of the Animal Kingdom. The body taken as a whole of any Radiate animal, our author denominates a Spherosome. Its homological segments are Spheromeres; the peculiar mouth of these creatures is the Actinostome. A community of Hydroids is an *Hydrarium*: a bunch of medusa buds arising from a Hydra is a *Medusarium*, a community of heterogeneous communities is a *Hydro-medusarium*. The useful application of these names we shall illustrate by a quotation. (Chap. ii. p. 81.)

"The use of such names for these different communities and their combinations, will greatly simplify our descriptions and add much precision to our characteristics of the different families and genera of the Hydroids. For instance, the *Tubularioids* as a family may be described as *Hydro-Medusaria*, arising from single *Hydra* which by budding and by stolons become Hydraria; each adult Hydra producing in time several pendant *Medusaria*. The different genera of the family may then be characterized by the peculiarities of their Hydræ, and of their Medusæ. The *Campanularians* as a family may be described as *Hydraria* with two kinds of *Hydræ*; some being sterile and more numerous, whilst others are fertile and produce Medusæ from their proboscis. The different genera may easily be distinguished by the peculiarities of the two kinds of Hydræ, as well as by their Medusæ. Similar differences exist among the Siphonophoræ. The *Velellidæ* are simply *Hydraria* arising from a single *Hydra*, which grows larger and larger until it produces other *Hydræ* of a different form, and from these single Medusæ buds spring forth and finally free themselves. The *Physalidæ*, on the contrary, are *Hydro-Medusaria*, arising, like the Velellidæ, from a single *Hydra*, which also grows larger and larger, and even acquires an enormous size, forming in the end the large swimming-bag, from which single additional Hydræ at first arise, and afterward a larger and larger number, forming several distinct *Hydraria*, suspended from the original enlarged Hydra. These Hydraria themselves consist of heterogeneous Hydræ, though of Hydræ only. Others produce *Medusaria* and thus become *Hydro-Medusaria*; so that a Physalia community is really made up of many heterogenous communities attached to a gigantic Hydra. The *Diphyidæ* are also *Hydro-Medusaria*, but of a very different kind from those of the Physalidæ. Here the community begins from a Medusoid individual, from which arises another Medusa, thus forming Medusa twins. This twin community produces a string of Medusoid Hydroids, from each of which arises another kind of Medusæ, in clos connection with their Hydroids, thus forming secondary twin communities, each of which consists of a Medusoid Hydra, and a genuine Medusa. In the *Physophoridæ*, the combinations are still different. The community constitutes also a *Hydro-Medusarium*; but it arises from a single *Hydra*, from the upper part of which bud sterile *Medusæ*, while other *Hydræ* arise from its lower part, between which, finally, a number of *Medusaria* make their appearances."

Those who only know the compound Acalephæ animals, which comparatively few naturalists can study in the living state, from the descriptions given in the ordinary books may be surprised at the above statements, which nevertheless they will soon find to shed a beautiful light over the whole of a very obscure subject.

The fifth section of this chapter on "Individuality and specific differences among Acalephs," furnishes our author with an occasion for remarks on Darwin's "Origin of Species," in which he earnestly and powerfully opposes the views of that writer, which now occupy so large a share of the attention of the lovers of Natural Science. In a former number of this Journal we copied from Silliman's journal the extract on this subject from the then unpublished volume now before us, and we only add a short passage which strongly expresses the convictions of one who eminently unites Philosophy with varied and novel practical observation in his researches. After referring to the polymorphism of the lower Acalephæ, he goes on to say:—

"But, notwithstanding this polymorphism among the individuals of one and the same community generically connected together, each successive generation reproduces the same kinds of heterogeneous individuals, and nothing but individuals, linked together in the same way. Surely, we have here a greater diversity of individuals, born one from the other, than is exhibited by the most diversified breeds of our domesticated animals; and yet all these heterogeneous individuals remain true to their species, in one case as in the other, and do not afford the slightest evidence of a transmutation of species. Would the supporters of the fanciful theories lately propounded, only extend their studies a little beyond the range of domesticated animals, would they investigate the alternate generations of the Acalephs, the extraordinary modes of development of the Helminths, the reproduction of the Salpæ, &c. &c., they would soon learn that there are in the world far more astonishing phenomena, strictly circumscribed between the natural limits of unvarying species, than the slight differences produced by the intervention of men, among domesticated animals; and perhaps, cease to be so confident as they seem to be, that these differences are trustworthy indications of the variability of species. For my own part, I must emphatically declare that I do not know a single fact tending to shew that species do vary in any way, while it is true that the individuals of one and the same species are more or less polymorphous. The circumstance that naturalists may find it difficult to trace the natural limits of any one particular species, or the mistakes that they may make in their attempts to distinguish them, has [have] nothing whatsoever to do with the question of their origin."

We must not pretend to follow the learned author too closely through the contents of so large a volume. He establishes the claim of the class Acalephæ to the Ctenophoræ, which some distin-

guished naturalists have been disposed to connect with the Tunicated Molluscs, whilst at the lower extremity of the class he not only takes in the Hydroid Polypes but the Milleporæ and several other forms. He concludes the portion of his work forming the general introduction by an account of the various attempts at the classifica- of these animals, which is very valuable to the student, who could not without great difficulty have collected for himself the scattered materials. The remainder of the present volume is devoted to the first order of Acalephæ, Ctenophoræ. Their structural features must not be allowed to detain us farther than by a single short quotation to mark the character which gives them their name: (p. 164.)

"One of the most apparent peculiarities of the Ctenophoræ, consists of eight rows of locomotive flappers, extending along the eight vertical and peripheric chymiferous tubes, with which they are closely connected. As far as I can ascertain, all Ctenophoræ have eight such rows, though some of them are represented with only four and others with twelve. But their close connection with the ambulacral tubes, and the constancy of the number of these tubes in all the Ctenophoræ which I ever had the opportunity of examining, lead me to take it for granted that the typical number of the vertical rows of locomotive flappers must be eight. I am inclined to ascribe the conflicting statements upon this point to the marked inequality observed among these rows in different families. The fact is, that while they are all eight, of equal length and equal prominence in certain representatives of this order, in others there are four larger, longer and more prominent ones, and four shorter and smaller ones, differing more or less in their course. I hold, therefore, that the smaller rows may have been overlooked in those genera which are described as having only four rows of locomotive flappers; and that in those which are represented as having twelve rows, the vibratile cilia of the epithelial cells lining the digestive cavity, may have been mistaken for additional rows of locomotive flappers. Gegenbaur gives the same explanation of the singular figure of the Alcinoe papillosa of Delle Chiajè. The close connection which exists between the rows of locomotive flappers and the chymiferous tubes is so similar to the general organization of the ambulacral system of the Echinoderms, that I do not hesitate to consider these structures as homologous."

Passing by all that relates to the sub-orders and families of Ctenophoræ, and proceeding to the North American species, we must indulge ourselves in a descriptive quotation well fitted to excite the curiosity and admiration of every reader:

"There can be scarcely anything more beautiful to behold than such a living transparent sphere sailing through the water, coursing one way or another, now slowly revolving upon itself, then assuming a straight course, or retrograding, advancing, or moving sideways, in all directions with equal precision and rapidity; then stopping to pause, and remaining for a time almost immoveable, a slight waving of some of its vibrating organs easily counterbalancing the difference

of its specific gravity and that of the water in which it lives. So Pleurobrachia may appear at times, and so does it also appear when moving in a state of contraction. But generally, when active, it hangs out a pair of most remarkable appendages, the structure and length, and contractility of which are equally surprising, and exceed in wonderful adaptation, all I have ever known among animal structures. Two apparently simple, irregular, and unequal threads hang out from opposite sides of the sphere. Presently these appendages may elongate, and equal in length the diameter of the sphere, or surpass it, and increase to two, three, five, ten, and twenty times the diameter of the body, and more and more; so much so that it would seem as if these threads had the power of endless extension and development. But as they lengthen they appear more complicated, from one of their sides other delicate threads shoot out like fringes, forming a row of beards like those of the most elegant ostrich feathers, and each of these threads itself elongates till it equals in length the diameter of the whole body, and bends in the most graceful curves. These two long streamers, stretching out in straight or undulating lines, sometimes parallel, then diverging or variously curving, follow the motions of the main sphere, being carried on with it in all its movements, which are no doubt influenced by them to a considerable extent. Upon considering this wonderful being, one is at a loss which most to admire, the elegance and complication of that structure, or the delicacy of the colours and hues, which, with the freshness of the morning dew upon the rose, shine from its whole surface. Like a planet round its sun, or, more exactly, like the comet with its magic tail, our little animal moves in its element as those larger bodies revolve in space, but unlike them, and to our admiration, it moves freely in all directions; and nothing can be more attractive than to watch such a little living comet as it darts with its tail in undetermined ways, and revolves upon itself, unfolding and bending its appendages with equal ease and elegance, at times allowing them to float for their whole length, at times shortening them in quick contractions and causing them to disappear suddenly, then dropping them as it were from its surface so that they seem to fall entirely away, till, lengthened to the utmost, they again follow in the direction of the body to which they are attached, and with which the connection that regulates their movements seems as mysterious as the changes are extraordinary and unexpected. For hours and hours I have sat before them and watched their movements, and have never been tired of admiring their graceful undulations. And though I have found contractile fibres in these thin threads, showing that these movements are of a muscular nature, it is still a unique fact in the organization of animal bodies, that parts may be elongated and contracted to such extraordinary and extensive limits by means of muscular action."

We must bring this notice to a conclusion. We cannot speak too highly of the merit and interest of the work, or of the beauty, effectiveness and usefulness in conveying information of the numerous plates which accompany it. The work has met with liberal patronage, and neither author nor publisher has spared any pains to deserve it both by the originality and value of the matter, and by the sumptuous manner in which it is brought before the public. W. H.

Narrative of the Canadian Red River Exploring Expedition of 1857, *and of the Assiniboine and Saskatchewan Exploring Expedition of* 1858. By Henry Youle Hind, M.A., F.R.G.S., Professor of Chemistry and Geology in the University of Trinity College, Toronto. 2 vols., 8vo. London: Longman & Co. 1860.

In the year 1858 there was issued from the press of the Provincial Government, a Canadian *Blue Book*, "printed by order of the Legislative Assembly," and embodying the "report on the exploration of the country between Lake Superior and the Red River Settlement." In 1859 a second *Blue Book*, printed by the same authority, reported the result of another exploratory expedition, to survey the valleys of the Assiniboine and Saskatchewan rivers. Both reports were illustrated with maps, sections, and wood-cuts of geological and other objects of interest; and attracted fully as much attention as the most interesting of blue books usually do. A review in our own pages, directed the attention of our readers to some of the most attractive of their varied contents; and the Canadian press generally published notices and extracts from them. But it is an old saying that Parliament can print blue books, but it is beyond its power to make people read them; and we doubt if the "Red River" and "Assiniboine" Blue Books furnished any very notable exception to this popular dictum. Extracts and digests in the periodical press sufficed to gratify popular enquiry; a few copies were bound and placed on the shelves of both public and private libraries, both here and at home, and the remainder, it is to be feared, experienced the usual fate of Blue Books, however valuable. But the enterprising leader of those expeditions wisely conceived that the subject treated of in his two reports merited a wider and more enduring interest; and the two handsome and copiously illustrated volumes, now issued from the London press, suffice to show what good editing and liberal publishing zeal can effect. A soldier returned from a rough campaign tattered, travel-stained, and way-worn, does not differ more marvellously from the hero set forth by the most fashionable of army tailors for a review or presentation at Court, than does the Blue Book of our Canadian Parliamentary press from these gay volumes, with their chromo-xylographs, wood-cuts, maps, and sections. The very wood-cuts which had already figured in the first issue are scarcely recognisable in their new and greatly improved aspect, under the combined effects of good paper and London printing.

From the attention which those expeditions have already excited in the Province, and the extent of our former notice of them, it is scarcely necessary that we should now do more than call attention to this revised edition of the reports. They have been augmented by information derived from various sources; new maps and plans greatly add to their practical value, and the whole work is reproduced in a highly creditable permanent form. To the topographer it supplies much valuable material; the ethnologist will find in it many references full of interest to him; while to the future historian of the extending provinces and colonies of British North America it will be indispensable as a book of reference. In this latter department, the history of British America, like that of our great Indian Empire, is intimately interwoven with that of one of the great trading companies of the remarkable people whom the first Napoleon sneeringly designated a nation of shopkeepers. That they do now constitute a nation dependent for their enduring greatness on their world-wide trading relations and commercial enterprise is indisputable; and among the powerful trading corporations by which their territorial influence and wealth have been extended, an important place must be given to that company, which, deriving its name from the great Arctic Bay that bears the name of the bold explorer Henry Hudson, has extended its forts and trading-posts from the Gulf of the St. Lawrence to Vancouver's Island and the shores of the Pacific and Arctic Oceans. Professor Hind gives this condensed sketch of the great Fur Company's history:

"The Hudson's Bay Company was incorporated in the year 1670, under a royal charter of Charles the Second, which granted them certain territories in North America, together with exclusive privileges of trade and other rights and advantages. During the first twenty years of their existence the profits of the Company were so great that, notwithstanding considerable losses sustained by the capture of some of their establishments by the French, amounting in value to £118,014, they were enabled to make a payment to the proprietors in 1684 of fifty per cent., another payment in 1688 of fifty per cent., and a farther payment in 1689 of twenty-five per cent.

In 1690 the stock was trebled without any call being made, besides affording a payment to the proprietors of twenty-five per cent. on the increased or newly created stock; from 1692 to 1697 the Company incurred loss and damage to the amount of £97,500 sterling from the French. In 1720 their circumstances were so far improved that they again trebled their capital stock, with only a call of ten per cent. from the proprietors, on which they paid dividends averaging nine per cent. for many years, showing profits on the originally subscribed capital stock

actually paid up of between 60 and 70 per cent. per annum from the year 1690 to 1800, or during a period of 110 years.

Up to this time the Hudson's Bay Company enjoyed a monopoly of the fur trade, and reaped a rich harvest of wealth and influence.

In 1783 the North-West Company was formed, having its head-quarters at Montreal. The North-West Company soon rose to the position of a formidable rival to the Hudson's Bay Company, and the territory the two companies traded in became the scene of animosities, feuds and bloodshed, involving the destruction of property, the demoralization of the Indians, and the ruin of the fur trade. Owing to this opposition, the interest of the Hudson's Bay Company suffered to such an extent, that between 1800 and 1821, a period of twenty-two years, their dividends were, for the first eight years, reduced to four per cent., during the next six years they could pay no dividend at all, and for the remaining eight years they could pay only four per cent.

In the year 1821 a union between the North-West and Hudson's Bay Companies took place, under the title of the last named. The proprietary were called upon to pay £100 per cent. upon their capital, which, with the stock in trade of both parties in the country, formed a capital stock of £400,000, on which four per cent. dividend was paid in the years 1821 to 1824, and from that time half yearly dividends of five per cent. to 1828, from 1828 to 1832 a dividend of five per cent. with a bonus of ten per cent. was paid, and from 1832 to 1837 a dividend of five per cent., with an average bonus of six per cent. The distribution of profits to the shareholders for the years 1847 to 1856, both inclusive, was as follows:—

1847—1849, ten per cent. per annum; 1850, twenty per cent. per annum, of which ten per cent. was added to stock; 1851, ten per cent.; 1852, fifteen per cent., of which five per cent. was added to stock; 1853, £18 4s. 6d., of which £8 4s. 6d. was added to stock; 1854 to 1856, ten per cent. per annum dividend. Of 268 proprietors in July 1856, 196 have purchased their stock at from 220 to 240 per cent.

The affairs of the Hudson's Bay Company are managed by a Governor-in-chief, sixteen chief factors, twenty-nine chief traders, five surgeons, eighty-seven clerks, sixty-seven post masters, twelve hundred permanent servants, and five hundred voyageurs, besides temporary employés of different ranks, chiefly consisting of voyageurs and servants. The total number of persons in the employ of the Hudson's Bay Company is about 3000.

Sir George Simpson has been Governor of the Hudson's Bay Company for forty years. He exercises a general supervision over the Company's affairs, presides at their councils in the country, and has the principal direction of the whole interior management in North America.* The Governor is assisted by a council for each of the two departments into which the territory is divided.

The seat of council for the Northern department is at Norway House, on Lake Winnipeg; for the southern department at Michipicoten, Lake Superior, or Moose Factory, on James's Bay.

* Before the volumes reached Canada death had deprived the Company of their long-tried and efficient Governor.

The council consists of the chief officers of the Company, the chief factors being ex-officio members of council. Their deliberations are conducted in private. The sixteen chief factors are in charge of different districts in the territory, and a certain number of them assemble every year at Norway House, for the northern department, generally about the middle of June, to meet the Governor and transact business. Seven chief factors, with the Governor, form a quorum, but if a sufficient number of the higher rank of officers are not present, a quorum is established by the admission of chief traders.

The Hudson's Bay Company's operations extend not only over that part of North America called Rupert's Land and the Indian territory, but also over part of Canada, Newfoundland, Oregon, Russian America, and the Sandwich Isles. The following table exhibits the number of departments and district posts into which this immense territory is divided for the prosecution of the fur trade:—

Country.	Departments.	Districts.	No. of Posts.
Part of Indian territory and part of Rupert's Land.	Northern.	Athabaska	4
		McKenzie River	11
		English River.	5
		Saskatchewan	9
		Cumberland	3
		Swan River	6
		Red River	6
		Lac la Pluie	7
		Norway House	2
		York	5
Part of Rupert's Land, and Canada.	Southern.	Albany	4
		Kmogumisse	2
		Lake Superior	9
		Lake Huron	5
		Sault St. Mario	1
		Moose	4
		East Main	3
		Rupert's River	3
		Temiscamingue	6
Newfoundland and part of Rupert's Land.	Montreal.	Fort Coulonge	3
		Lac des Sables	2
		Lacluire	1
		St. Maurice	3
		King's Posts	6
		Mingan	2
		Esquimaux Bay	4
Part of Indian territory, Washington territory, U.S. and Oregon, U.S.	Oregon.	Columbia	8
		Colville	5
		Snake Country	3
Vancouver's Island, part of Indian territory and Russian America.	Western.	Vancouver's Island	2
		North-West Coast	1
		Thompson's River	1
		New Caledonia	8
3 Independent Countries.	5 Depmts.	33 Districts.	152 Posts.

From the foregoing table it appears that the operations of the Hudson's Bay Company extend over territories whose inhabitants owe allegiance to three different and independent governments, British, Russian, and the United States. These immense territories, exceeding 4,500,000 square miles in area, are divided, for the exclusive purposes of the fur trade, into four departments and thirty-three districts, in which are included one hundred and fifty-two posts, commanding the services of three thousand agents, traders, voyageurs, and servants, besides giving occasional or constant employment to about one hundred thousand savage Indian hunters. Armed vessels, both sailing and steam, are employed on the North-West Coast to carry on the fur trade with the warlike natives of that distant region. More than twenty years ago the trade of the North-West Coast gave employment to about one thousand men, occupying twenty-one permanent establishments, or engaged in navigating five armed sailing vessels, and one armed steamer, varying from one hundred to three hundred tons in burden. History does not furnish another example of an association of private individuals exerting a powerful influence over so large an extent of the earth's surface, and administering their affairs with such consummate skill and unwavering devotion to the original objects of their incorporation."

This is a remarkable chapter in British Colonial History. The capital, property, and investments, of the company were set down by one of their own officials in 1856 at the immense sum of one million two hundred and sixty-five thousand and sixty-seven pounds sterling; and its influence over the destinies alike of natives and settlers throughout the vast area extending from the Atlantic to the Pacific shores, is all-predominant and unchecked.

The history of the Selkirk colony of Red River curiously illustrates the relations alike of Indians and European settlers to the all-powerful trading company.

"The Indian wars undertaken by the United States Government during the last half century, have cost infinitely more than the most liberal annuities or comprehensive efforts for the amelioration of the condition of the aborigines would have done; and in relation to the northern prairie tribes, war is always to be expected at a day's notice.

"The encroachments of western settlers upon Indian lands are constant and increasing in the United States, and there is no reason to suppose that these encroachments will diminish for many years to come. Already the Red River south of the boundary line, as well as its south-western tributaries, are invaded from the valley of the Mississippi, and as the territory of Dakotah has not yet been ceded to the United States Government, the prospect of a war with the Sioux, whose hunting grounds embrace it, becomes daily more imminent. Lieutenant Warren, who has conducted several United States' exploring expeditions in Dakotah and Nebraska territories, remarks:—"The advance of the settlements is universally acknowledged to be a necessity of our national development, and is justifiable in displacing the native races on that ground alone. But the Govern-

ment, instead of being so constituted as to prepare the way for settlement by wise and just treaties of purchase from the present owners, and proper protection and support for the indigent race so dispossessed, is sometimes behind its obligations in these respects; and in some instances Congress refuses or delays to ratify the treaties made by the duly authorized agents of the government. The result is, that the settler and pioneer are precipitated into the Indian's country, without the Indian having received the first consideration promised him; and he often, in a manner that enlists the sympathies of all mankind, takes up the tomahawk in defence of his right and perishes in the attempt." The same officer states that there are so many inevitable causes at work to produce a war with the Dakotahs (Sioux) before many years, that he regards the greatest fruit of his explorations to be the knowledge of the proper routes by which to invade their country and conquer them, but at the same time he thinks that many of the causes of war with them might be removed by timely action in relation to the treaties made with them.

"The country of the Dakotahs borders on British territory, some of tne tribes are the confirmed enemies of the half-breeds and Ojibways of Red River; peace has often been made, but as often broken again upon trivial and even accidental grounds.

"The frontier tribes can muster at least two thousand warriors by uniting with several of their more southern allies. Being the most warlike and numerous Indians in the United States territories, and their hunting grounds interlocking with those of the Crees in British America, they will probably yet play an important and active part in the future of the colony and the new adjoining territory of Chippewa.

"Thickwood Crees, Swampy Crees, Plain Crees, and Ojibways are the Indian nations who now occupy that part of Rupert's Land where settlements would first be made. These nations are friendly to one another and hostile to the Sioux. They are, in fact, the hunters of the Hudson's Bay Company, and consequently friendly with that body, who have never sought to extend the settlements of the white race in Rupert's Land; but of late years since the questions relating to title to lands, annuities, and compensation have been raised, they are becoming dissatisfied, suspicious, and untrustworthy.

"The Right Honourable Edward Ellice, M.P., in reply to a question put by Mr. Christie during his examination before the Select Committee on the Hudson's Bay, respecting the extinction of the Indian title in Rupert's Land, stated that "the English Government never extinguished the Indian title in Canada when they took possession; the Americans, while they have been extending their possessions, have extinguished the Indian title, but in Canada there has never been any treaty with the Indians to extinguish the title; the Crown, retaining certain reserves for the Indians, has always insisted upon the right to occupy the lands, and to grant the lands."

"Great and apparently reasonable doubts exist respecting the Indian title to that part of the valley of Red River and Assinniboine now occupied by the settlements. The royal charter for incorporating the Hudson's Bay Company, granted by Charles II., A.D. 1670, transferred to the Company the trade, lands,

mines, minerals, fisheries, &c., of Rupert's Land. The territory to be reckoned one of his Majesty's plantations or colonies in America, and the Governor and Company to be the Lords Proprietors of the same for ever.

"On the 12th June, 1811, the Hudson's Bay Company made a grant of lands to Lord Selkirk included within the following boundaries:—"All that tract of land or territory bounded by an imaginary line running as follows, that is to say, beginning on the western shores of the Lake Winnipeg at a point in 52° 30' north latitude, and thence running due west to the Lake Winnepego-sis, then in a southerly direction through the said lake so as to strike its western shore in latitude 52°, then due west to the place where the 52° intersects the western branch of Red River, the Assinniboine River, then due south from that point of intersection to the height of land, which separates the waters running into Hudson's Bay from those of the Missouri and Mississippi, then in an easterly direction along the said height of land to the source of the Winnipeg River (meaning by such last named river the principal branch of the waters which unite in Lake Seiganagah,) thence along the main stream of these waters, and the middle of the several lakes through which they flow, to the mouth of the Winnipeg River, and thence in a northerly direction through the middle of Lake Winnipeg to the place of beginning."

Ross, in his "Red River Settlement, its Rise, Progress, and Present State," introduces a treaty made between Lord Selkirk and certain Indian chiefs, Crees and Saulteaux (or Ojibways,) on the 18th July, 1817, in which the chiefs agree to give unto the king, for the use of the Earl of Selkirk, a considerable tract of land on the Assinniboine and Red Rivers for the quit-rent of 100 lbs. of tobacco, to be paid annually to the chiefs and warriors of the Cree and Saulteaux tribes then occupying the country.

"In 1857 Peguis, an immigrant from Pigeon River, Lake Superior, at Red River, sent a letter to the Aborigines' Protection Society, London, complaining of the non-fulfilment of this treaty. The following extract from the letter sent by Peguis is published in the Blue Book:—

"Many winters ago, in 1812, the lands along the Red River, in the Assinniboine country on which I and the tribe of Indians of whom I am chief then lived, were taken possession of, without permission of myself or my tribe, by a body of white settlers. For the sake of peace, I, as the representative of my tribe, allowed them to remain on our lands on their promising that we should be well paid for them by a great chief, who was to follow them. This great chief, whom we call the silver chief (the Earl of Selkirk), arrived in the spring after the war between the North-West and Hudson's Bay Companies (1817). He told us he wanted land for some of his countrymen, who were very poor in their own country; and I consented, on the condition that he paid well for my tribe's land, he could have from the confluence of the Assinniboine to near Maple Sugar Point on the Red River (a distance of twenty to twenty-four miles), following the course of the river, and as far back on each side of the river as a horse can be seen under (easily distinguished). The Silver Chief told us he had little with which to pay us for our lands when he made this arrangement, in consequence of the troubles of the North-West Company. He, however, asked us what we most required for the present, and we told him we would be content till the following year, when he

promised again to return, to take only ammunition and tobacco. The Silver Chief never returned, and either his son or the Hudson's Bay Company have ever since paid us annually for our lands only the small quantity of ammunition and tobacco which in the first instance we took as a preliminary to a final bargain about our lands."

In March, 1859, Peguis dictated another letter on the subject of the title of his tribe to a portion of the lands on Red River. This singular communication, as published in the "Aboriginies' Friend and Colonial Intelligencer," is as follows:

"I Peguis, + (his mark), Salteaux Chief of the Indian Settlement at Red River, wish to make my statement to the Great House across the great waters.

"I and my people have our minds much disturbed by the Hudson's Bay Company, because the said Company have never arranged with me for our lands. We never sold our lands to the said Company, nor to the Earl of Selkirk; and yet the said Company mark out and sell our lands without our permission. Is this right? I and my people do not take their property from them, without giving them great value for it, as furs and other things, and is it right that the said Company should take our landed property from us without our permission, and without our receiving payment for the same? I have asked the said Company for payment, through their agents, and I asked Mr. Mactavish for the same thing, last spring, but I got nothing for my lands.

"If I were nearer the Great House, I would speak much and loud. I and my people are disturbed, and will the Great House approve of another Fur Company being chartered from Canada? Will there be another Company for the North, and another for the South? Will the Great House sanction more hostilities as before, when there were two Fur Companies trading in our country? And will another Company take in land for five miles on each side of the great road to be made between this place and Canada, without consulting me and my brother chiefs? I speak loud: listen! We have had enough of all Fur Companies. Please send us out rather mechanics and implements to help our families in forming settlements, and to secure as reserves," &c.

The subject thus referred to is still unsettled. An annual payment of £8 sterling has been made by the Hudson's Bay Company, regularly since 1812, to certain Indians and their descendants, in fulfilment of the treaty with Lord Selkirk; but the Indians now deny that the Cree Chief, who alone had the right of disposal, ever parted with the land either to the Earl of Selkirk or to the Fur Company; and future difficulties with Assinniboines, Plain Crees, and Objibway Indians, will have to be dealt with in some satisfactory way before an undisputed title can be acquired to the coveted lands in this territory.

These extracts and notices may uffice to illustrate the interest which attaches to the volumes in question. Many other subjects of equal value are discussed. The routes of travel, future lines of road, character and resources of the country, statistics of population, and

the industry, trading, and missionary enterprise, of the various districts explored, are all treated of in detail. Indian customs, superstitions, and general characteristics, as well as the history of the curious mixed population growing up within the Company's territories, supply materials for another series of chapters; while a third is devoted to the geological and palæontological characteristics of the country explored. Numerous illustrations add to the minuteness and value of those details; and combine to form a work which ought to find a place in every public library in Canada. D. W.

The Manufacture of Vinegar; its theory and practice. By Charles M. Wetherill, LL.D., M.D., &c. &c. Philadelphia: Lindsay and Blackiston.

Vinegar is a substance which is used so extensively both in domestic life and in many of the useful arts, that its cheap and certain manufacture has of late years become a subject of considerable importance. For persons requiring any large amount of vinegar in their domestic economy, and especially if living at any great distance from towns, the knowledge of a sure process of manufacture is very desirable, not only on account of a possibility of a failure in the supply, but also on the score of economy. Vinegar even for domestic purposes is used in large quantities, especially in the preparation of those hideously indigestible pickled cucumbers which form so frequent an addition to the dinner table on this continent, and being a bulky article, containing but little of the acidifying principle in comparison with the water, the cost of transport becomes considerable, and the marketable price far beyond that for which it can be manufactured in every private farm house. A few pounds of starch obtained from damaged wheat, from Indian corn, from potatoes (even diseased ones,) or a like quantity of sugar obtained from the maple or the sorghum, or even a gallon of unrefined maple or sorghum molasses, will, with proper management, yield an amount of excellent vinegar, which in most country places could only be purchased by the expenditure of many dollars.

The above mentioned work is well calculated to afford all necessary information on the subject, not only to the manufacturer in the larger towns, but also to the Paterfamilias of our rural districts. Many treatises have been written on the subject, among which none

is more complete than the elaborate one of Otto, to which our author with most commendable frankness, owns his material indebtedness. Although much of the work before us is therefore merely a translation from Otto, the community is not the less indebted to Dr. Wetherill for the production of a very readable and carefully compiled work on this subject, especially as it contains in addition the results of much personal experience.

The work is divided into two sections, the first treating of the chemical history of those substances which are used in the production of vinegar, of the theory of its formation, and of its chemical history generally; the second of the purely practical part of its manufacture. Perhaps our author's work might have been as useful if confined to the second portion, but any one who desires to enter upon the manufacture of vinegar whether for domestic or manufacturing purposes, will not find himself any the worse for an attentive perusal of the preceding pages. He will be much less likely to fall into error, and will be better enabled to remedy any defect which may occur in the process of manufacture.

The very complete second part of the present work, in which all necessary practical details are fully described, is not of such a character as to admit of much remark, but a few observations may be made on the first part, in which our author first treats of the history of vinegar or acetic acid, of chemical principles generally, of sugar, cellulose, starch, gum, dextrine, &c., with their various modifications, of alcohol and fermentation, malting, brewing, hydrometers, &c., and lastly of acetic acid, its strength, properties, and the theory of its preparation.

In the historical portion, our author, with a laudable anxiety to enhance the value of the substance of which he is treating, endeavours to prove its great antiquity, and in support of this proposition, affirms that it must have been known to Noah, as he "drank of wine" to intoxication, and wine is converted into vinegar by keeping. The reasoning is ingenious but the deduction somewhat illogical, inasmuch as if Noah used his wine so freely as to induce intoxication, the probabilities are that he never kept it sufficiently long to form vinegar. That it was known at the time of Solomon appears from the following passage from the Proverbs, "As he that taketh away a garment in cold weather, and as vinegar upon nitre, so is he that singeth songs to a heavy heart," where nitre probably

signifies carbonate of soda or potassa. Cleopatra is said to have swallowed the value of a million sesterces in pearls dissolved in vinegar. Geber in the eighth century first described the method of concentrating vinegar by distillation. Wood vinegar, which was long considered to be a distinct substance and known under the name of pyroligneous acid, was described as early as 1648 by Glauber, as resulting from the distillation of vegetable substances. Dr. Wetherill states that "this and alcohol are the only sources of acetic acid if we except the brilliant researches of Berthelot." It may be remarked that the formation of acetic acid from the products resulting from the action of chlorine on sulphide of carbon, was known long before Berthelot commenced his researches.

The first step towards improvement in the manufacture of vinegar dates from the year 1822, when Döbereiner discovered the possibility of converting alcohol into acetic acid by means of air and spongy platinum; from this has arisen the so-called quick process of manufacture which bids fair to supersede the older methods of fabrication. Our author states that on this continent this process is still held to be a secret and often sold for exorbitant prices, a statement which from our own experience we can perfectly confirm for Canada.

The only advantage which the old process, consisting in a slow acetification or conversion into vinegar of beer or wine, possesses over the new, is derived from the fact that by the old process certain ethereal and aromatic substances are generated which do not appear when vinegar is made from alcohol, especially if pure, and to which the pleasant flavours of beer and wine vinegar seem to be due. This objection may, however, be obviated by the addition of a trace of these essences artificially prepared to the vinegar generated by the quick process. Dr. Wetherill enters into the subject of these fruit flavours rather largely, and fully confirms the opinion expressed by the writer in a former number of this journal, as to the harmlessness of the compounds thus used. Indeed our author submitted the matter, as regards one of the essences, to a very striking proof, a true experimentum crucis, for he states that in order to test the innocuousness of the so-called essence of Jargonelle pear, he consumed a whole pound of pear drops, without "experiencing any injurious effect.' Any injury done, must we conceive have been to the confectioner, for it seems highly improbable that the Dr. would ever eat any more pear drops for the rest of his life.

Chapter I.—Treats of chemical principles generally, and contains a description of those elements which as entering into the composition of vinegar or its producers, are of interest to the manufacturer.

Chapter II.—Treats of cellulose and lignine or woody fibre, starch and its conversion into sugar, dextrine, gums, diastase and the sugars. It is stated under the head of Milk Sugar, that the "Tartars ferment the milk of their mares to form the alcoholic drink kouhmiss, which when distilled yields the spirit called arrack." We were always of opinion that arrack was obtained from the fermentation of rice, and that the spirit procured from Kouhmiss was called Asa.

Our author objects to the term grape sugar, as grapes do not contain the modification thus designated, and substitutes raisin sugar, a change for which there does not seem to be any valid reason, inasmuch as it is only old raisins and not these that are new and fresh, which contain true grape sugar. The name glucose is also objected to, inasmuch as grape sugar is not so sweet as that from the cane, an objection which seems of little value, as after all glucose is sweet, and the name is not intended to show that it is the sweetest of all sugars. The term dulcose has been proposed with some reason, instead of glucose, on account of the termination *osus* being essentially Latin.

We can scarcely imagine that our author has himself tried the test for cane sugar mentioned at page 78, viz.,—boiling with dilute sulphuric acid, if he had, he would certainly not have recommended it.

Chapter III.—Contains a very full account of alcohol, its chemical nature, its presence in wines and all fermented liquors, the methods of determining its strength, and the calculations necessary for preparing a mixture which shall contain a definite quantity, together with a full description of the different processes of malting, fermenting and brewing generally, by which any one may prepare for himself an alcoholic liquid from the substances described in the preceding pages, and adapted for the manufacture of vinegar.

Chapter IV.—Contains a chemical history of acetic acid, and copious extracts from Otto's work on the different methods of determining the strength, and hence the marketable value of any sample of vinegar.

The second part contains the information most valuable to the manufacturer, consisting of very plain and full descriptions of the

old and new processes, both as applicable to domestic purposes, and to the preparation of vinegar on the large scale. Although there is certainly a large portion of the above work which might have been omitted without greatly detracting from its usefulness, yet on the whole it may be safely recommended as a very complete and trustworthy manual on this particular branch of manufacture.

H. C.

Contributions to Palæontology, 1858 *and* 1859, *with additions in* 1860. By James Hall, Geologist and Palæontologist. (Thirteenth Annual Report of the Regents of the State Cabinet, &c., of Albany.) 1861.

It has been said that to stand still in science is really to retrograde. If this be true of science in general, it is more especially true of palæontology. Within the last ten years, to carry our retrospective view no farther, the entire domain of this science has been subjected to many and material changes; and, as these are still going on, our most elaborate works become rapidly obsolete, or fail, at least, to keep up with the progress of the time. In this light, the valuable contributions of Professor Hall to American Palæontology, as published in the Reports of the Regents of the University and State Cabinet of Albany, are always welcome. The present series embraces a wide field: Graptolites, Brachiopods, Cephalopods, Trilobites, and other types, come under review; and new forms and points of structure are educed in each. Amongst the graptolites, a species of Barrande's genus *Rastrites*, hitherto unrecognised on this continent, is figured and described from the Hudson River shales of the environs of Albany. Some curious illustrations are also given of the old species *G. gracilis*, a form which will probably be found to include several of the more recently established species. Notwithstanding the comparatively perfect structures obtained from the Quebec rocks, our knowledge of the true nature of the graptolite still remains obscure, and much uncertainty prevails respecting the characters on which species may be legitimately founded. In the linear forms, so far as present observation goes, the form and comparative distances of the serratures or cells, appear to be the only trustworthy characters (and that only in part) available for this purpose. If the mode of branching, or that of the general aggregation of the stipes be employed, it is evident that many identical forms will be described under different specific

names. In the work before us, Professor Hall proposes two new genera: *Reteograptus* and *Thamnograptus*. The former is characterised by the reticulated structure of the entire stipe (as in the *G. tentaculatus* of Point Levy, described by the author in the Geological Report of the Canadian Survey for 1857) and thus resembling to some extent the genus *Retiolites* or *Gladiolites* of Barrande, but the serratures do not reach the central cells. In the new genus *Thamnograptus*, on the other hand, the stipe appears to be entirely destitute of cells or serratures of any kind.

Amongst the Brachiopods, several new genera, in addition to those described more or less recently by the author, are also proposed; but the data on which these are founded, appear to be somewhat unsatisfactory. As regards fossil forms, which so greatly outnumber living species in this class of mollusca, the classification-characters, indeed, are beset in their application, and throughout the entire group, with almost insurmountable difficulties. The earlier genera were established, to a great extent, on external characters of more or less easy employment; but it soon became evident that many species were thus placed in forced or artificial collocation: as, although alike externally, their inner structure was frequently found to be entirely distinct. Thus, the forms of the genus *Athyris* became separated from *Terebratula* (or mostly so,) by their internal calcareous spires, and placed properly amongst the *Spiriferidæ*, although a straight hinge-line was originally thought to be one of the essential characters of these latter. In *Terebratella*, again, the supposed arched hinge-line of the *Terebratulæ* was shewn to be an uncertain or artificial character. But many internal points of brachiopodous structure, besides being of difficult, and frequently of impossible observation, may be also to some extent of little value as natural classification-elements. It seems clear, at least, that subdivisions based on minute and subordinate internal characters, may be pushed too far. All palæontologists must agree that it is at present next to impossible to refer certain fossils of this class to their proper genera, and the difficulty will not only be much increased by minute generic distinctions founded on characters that cannot be observed in the great majority of examples, but each separate species bids fair to become eventually the type of a distinct genus.

The new genera proposed by Professor Hall are named respectively, *Skenidium*, *Ambocœlia*, *Vitulina*, *Meristella*, and *Leiorhynchus*; with *Rhynchotrema* as a doubtful genus, founded on the old *Rhynconella in-*

crebescens, certain examples of which have been found to exhibit a well-marked area. The genus *Skenidium*, founded on *orthis insignis*, is characterized by the prolongation of the cardinal process into a median septum which extends to the base or front margin of the shell, and occasionally bifurcates at this lower extremity. In the typical species, the area is large and triangular, but this character, although cited by the author in the generic description, is probably more or less inconstant. It would, at least, be manifestly unsafe to refer to this genus (allowing it to be really distinct) all the orthis-like forms with large area, high ventral valve, and radiating striæ, where other characters could not be observed; and yet, in nine cases out of ten, these external characters are alone open to us. The genus *Ambocœlia*, of which the long-known *orthis umbonata* of Conrad is the type, possesses a large and curved beak in the highly convex ventral valve, and a four-parted muscular impression near the centre of the dorsal valve. The proposed genus *Vitulina* somewhat resembles the author's *Tropidoleptus*, but the dental processes are not crenulate, nor distinctly separated from the area, as in the latter. One species only is cited: *V. pustulosa* from the Hamilton Group of Genesee County, New York. The genus *Meristella* is separated from *Merista* (with which the author's *Camarium* is now seen to be identical) by the absence of the peculiar arched, or "shoe-lifter," process, belonging to the ventral valve of that genus. From *Athyris*, on the other hand, it is distinguished chiefly by the presence of a well-marked median septum, absent, or rudimentary, in the former, and by a slightly different muscular impression; but these characters are surely insufficient to warrant the separation, even if they should prove to be constant. Finally, *Leiorhynchus* is made to include the meristella or athyris-like forms with plications on the central portion (or, occasionally, on the entire surface) of the shell. Internal spires have not yet been recognised, so that the family to which this type should be referred, cannot be strictly determined; and great difficulty must be experienced, if the genus be adopted, in distinguishing many of its species from those of *athyris* or *rhynconella*.

In the Devonian rocks of Western Canada, the genus *Lingula* appears to be of exceedingly rare occurrence, but, from strata of this age in New York, Professor Hall has described several species of comparatively large size, together with a large species of *Discina*, and several species of *Crania*. Some forms referred to the genus *Tere-*

bratula, are also described. These have a punctate shell-structure, but the internal characters have not been made out.

A considerable portion of the work before us, is devoted to descriptions of new goniatites and related forms, from the Hamilton Shales and other Devonian strata of New York. We may attempt an analysis of these, in another number of the *Journal*, but the large space occupied by other articles in the present number, compels us to pass them by with this brief allusion. Well-executed figures are given of most of the species.

Towards the close of Professor Hall's Report, we have some additional remarks on the trilobites of the "Quebec shales" of Georgia, Vermont. These forms, it will be remembered, have given rise to much recent discussion, both on this continent and in Europe, and have made known to us the undoubted presence of an American "primordial zone." These trilobites have hitherto been referred to the genus *Olenus* (or, by Professor Hall, to *Olenus* and *Peltura*), but the author now considers them entitled to the rank of new and distinct genera, upon which he bestows the names of *Barrandia* and *Bathynotus*. The species formerly referred by him to *Peltura* he places under *Bathynotus*, and the two other species under *Barrandia*. This latter genus is undoubtedly a legitimate one, holding an intermediate place between *Paradoxides* and *Olenus*. It differs from Paradoxides, more especially, by the anterior contraction of the glabella; and from Olenus by its contracted pygidium, this latter being apparently composed of a single article, without the slightest trace of side lobes. In *Barrandia*, moreover, the *third* pleuræ are produced beyond the others. It appears to us, therefore, that this genus must hold good, so long as *Paradoxides* and *Olenus* are kept distinct;* but the two species placed under it, seem, on the other hand, to be identical. Considering the crushed state of the form referred to *B. Vermontana*, no certain conclusions can be drawn from the glabella, and the rounded anterior lobe of the glabella of *B. Thompsoni* might undoubtedly be so distorted by pressure as to produce the appearance exhibited by the other example. The produced horns of the head-shield are certainly much shorter in one form than in the other, but that is a character of no specific value, as exemplified by *Asaphus Canadensis* and other species of trilobites. The proposed genus *Bathynotus* may likewise prove to be well founded, but the im-

* The name *Barrandia* has already been applied, however, to a doubtful genus, by McCoy.

perfect condition of the solitary example on which it is based, scarcely warrants us to accept it, at present, otherwise than provisionally.

In bringing to a close, this rapid notice of Professor Hall's valuable contributions to palæontological science, as contained in the Report before us, we may congratulate our readers, who may be interested in this subject, on the near completion of the author's third volume of the Palæontology of New York. In this volume we are promised, in addition to much important matter regarding various fossil groups, some new and interesting details on the structure of *Eurypterus* and other crustaceans of a similar type. These details, it is stated, are of a far more complete character than those hitherto educed from European examples.

E. J. C.

Supplementary Chapter to Acadian Geology. By J. W. Dawson, LL.D., F. R. S., Principal of McGill College, Montreal. Edinburgh: Oliver and Boyd. Montreal: B. Dawson and Son. 1860.

The *Acadian Geology* of Dr. Dawson, a very elaborate treatise on the geological structure and characteristics of New Brunswick and Nova Scotia, published in 1855, was brought before the notice of our readers in an early Number of the Journal.* In the present "Supplementary Chapter" to this work, the author embodies the various discoveries and deductions, relating to the geology of these districts, which have accrued, since that time, from his own researches and those of other laborers in the same field. In this manner, the modern and Post-Pliocene deposits of Nova Scotia are briefly discussed and compared with those of Canada and Europe; and a succinct but very able review is given of the Coal Measures, with their vegetable, reptilian, and other remains. The illustrations presented in connection with the author's views on the structure of the *Sigillariæ* and other Carboniferous plants, are particularly interesting. All the new facts gleaned from recent examinations of the Silurian and Devonian strata of these provinces, are also brought together in a separate chapter, presenting as complete a view of the subject as the present state of our knowledge will admit. Dr. Dawson's valuable *Supplement*, therefore, regarded even as a separate work, will be found of the greatest service to all engaged in the study of American Geology.

E. J. C.

* Vol I. New Series, p. 39—46.

Coins, Medals, and Seals, Ancient and Modern; Illustrated and described. With a sketch of the history of coins and Coinage, instructions for young collectors, tables of comparative rarity, price lists of English and American coins, medals, and tokens, &c., &c. Edited by W. C. Prime, author of "*Boat Life in Egypt and Nubia,*" &c. New York: Harper and Brothers. 1861.

The author of this neatly executed and tastefully illustrated work begins his preface with the remark: "This volume is published without any pretence to novelty." There is, however, a very notable novelty in the issue of such a work with its preface dating from New York, and its copyright secured "in the Clerk's Office of the District Court" of that state, according to Act of Congress. As a popular hand-book for the young numismatist, it is a highly creditable and significant production. It undertakes too much within the compass of its two hundred and eighty pages to be of great practical value for the minute requirements of the experienced coin collector; but as an introduction to numismatic studies, and a help to the young beginner in the stocking and valuing of his cabinet, it is well suited for its purpose; while to the numismatist who feels any interest in the coins and medals of the New World, it offers some curious information, such as will be highly appreciated in some quarters. If it were our purpose to trace either the facts or the illustrations to their original sources, it would not be difficult to show the process of compilation by which the work has been got up; but we rather turn to the only department in which the numismatist has any reason to look for authoritative information on the subject treated of, viz., the mints and coinage of the New World.

Chapter VI. is devoted to the American Colonial and United States coinage, in which characteristically enough, the history begins with the primitive wampum, and the native systems of barter. From this may be learned what are the rare and prized treasures of the American numismatist; the Gomers Island piece of Bermuda, of which only three specimens are known; the Pine Tree coinage; and the Scrub Oak shilling of Massachusetts, a source of quarrel between the Colonists and the Crown, till a witty New Englander told Charles II. that the device was none other than the Royal Oak that saved his majesty's life.

A good story is told of John Hull, the Mint-master of Boston, by whom the Pine Tree money was coined. He received for his labour

and expenses, one shilling out of every twenty he coined; and by this toll in silver, he became at last one of the richest men in the colony. When his daughter was married to Samuel Sewall he accordingly settled her dowry by placing her on her wedding day in one scale, and filling the other with shillings till he outweighed her. The editor enters into an estimation of the probable weight of an average bride, and so estimates the worth of the fair lady by this curious standard. Along with pleasant illustrations of like kind, the book embodies much minute information, especially about the United States coinage of the early years which followed the Revolution, such as can not fail to be welcome to the collector; and along with this are minute tables of rare medals and coins, with the prices given for them at recent sales. The volume is well calculated to awaken a taste for numismatics in the young collector who may not hitherto have had his attention turned in that direction.

D. W.

CANADIAN INSTITUTE.

ANNUAL REPORT OF THE COUNCIL FOR THE YEAR 1860.

(Read before the Institute, Saturday, Dec. 15th, 1860.)

The Council of the Canadian Institute have the honor to present the following Report of the proceedings of the Society for the past year:—

Since the last Annual Report thirty-six new members have been elected, while a loss, from various causes, of forty-one members has been sustained, showing a decrease of five members during the year. The subjoined list shows the present state of the membership:—

Members at commencement of Session 1859–60		467
New Members elected, Session 1859–60		36
By the Council, during the recess		1
Total		503
Deduct—Deaths	8	
Withdrawn	25	
Left the Province	8	
		41
Total on 30th November, 1860		462

Composed of—	Honorary Members	5
	Life Members	35
	Corresponding Members	6
	Members	406
	Junior Members	10
	Total	462

The Council are glad to be able to report the continued efficiency of the library. During the year they have added thirty-nine volumes by purchase, and one hundred and two volumes have been received as donations from various sources. A list of the books added will be found appended to this Report. The number of volumes taken out by members during the year has been considerably larger than in any former year, showing a growing appreciation of the advantages offered by this important branch of the Institute.

COMMUNICATIONS.

The following list of Papers, read at the ordinary meetings held during the Session, will be found to contain many communications of value, and some of general interest:—

3RD DECEMBER, 1859.

Rev. J. McCaul, LL.D., "On Ancient Shields."

Professor E. J. Chapman, "On Canadian Minerals."

10TH DECEMBER.

John Rae, M.D., "On the Search for Sir John Franklin."

17TH DECEMBER.

Professor E. J. Chapman, "On the Geology of Belleville and surrounding District."

7TH JANUARY, 1860.

Professor H. Y. Hind, M.A., "On the Distribution of Clay Iron Stone in the Carbonaceous Rocks of Rupert's Land, or the North-Western Territory and its value as a source of Iron in that country."

14TH JANUARY.

F. Assikinack, Esq., "On some Peculiarities of the Odahwah Language."

Rev. Prof. W. Hincks, F.L.S. "Specimens of a Canadian Flora."

21ST JANUARY.

Hon. G. W. Allan, M.L.C. "On the Topography of the Roman Forum." Illustrated by a series of Photographic views.

Professor D. Wilson, LL.D., (the President.) "Observations on the Skull of a Circassian Lady, brought from Kertch in the Crimea."

28TH JANUARY.

Professor H. Y. Hind, M.A. "Remarks on Indian Art, illustrated by a collection of Indian relics, obtained during the Assinniboine and Saskatchewan Expedition."

Professor J. Bovell, M.D., "Observations on the Skull of an Indian infant, found with many others in a pit near Weston."

4TH FEBRUARY.

Professor J. Bovell, M.D., "Notes of a Visit to Barbadoes in 1859."

11TH FEBRUARY.

Rev. Professor W. Hincks, F.L.S., "On some Particulars in the Structure of the Brassicaceæ and Primulaceæ."

Professor G. T. Kingston, M.A., "On the Meteorological Phenomena of 1859."

18TH FEBRUARY.

Sandford Fleming, Esq., C.E., "On a new Construction of Railway Joints."

Professor Henry Y. Hind, M.A., "On the Manufacture of Shale Oil from the Utica Slate of Collingwood."

C. Fuller, Esq., "On the processes and results of Chromo-Lithography, illustrated by Drawings and Specimens of the process in all its stages."

25TH FEBRUARY.

Rev. W. S. Darling, "Remarks on the Manuscripts of the Middle Ages."

Rev. Professor G. P. Young, M.A., "On the Relation which can be proved to subsist between the area of a Plane Triangle and the sum of the Angles, on the Hypothesis that Euclid's 11th Axiom in any case fails."

Hon. G. W. Allan, M.L.C., "Notes on some of the Different Races composing the Population of the Valley of the Nile." Illustrated by coloured drawings procured by the Author when in Egypt.

3RD MARCH.

T. C. Wallbridge, Esq., "On some Ancient Mounds on the shores of the Bay of Quinté."

W. G. Tomkins, Esq., C.E., "On the Thickness of the Earth's Crust."

P. Freeland, Esq., "Notes on some Specimens of Diatomaceæ collected in the St. Lawrence, illustrated by Microscopical Specimens."

10TH MARCH.

Rev. Professor W. Hincks, F.L.S., "On the true Aims, Foundations, and Claims to attention of Political Economy."

D. Martin, "On some Geometric Problems, relating to Curves having double contact."

J. H. Dumble, Esq., C.E., "On the Expansion and Contraction of Ice."

17TH MARCH.

Professor E. J. Chapman, "On the Geological structure of the Blue Mountains near Collingwood." (2) "On some rules for calculating the thickness of inclined strata, and (3) On a new species of *Agelacrinites* from Peterboro', C.W."

Professor G. P. Young, M.A., "Proof of the impossibility of representing the common transcendental functions of a variable as finite Algebraical functions."

Professor D. Wilson, LL.D. (President), "On the origin of Alphabets in their reference to the question of the age of Man."

24TH MARCH.

Professor J. B. Cherriman, M.A., "Remarks on Newton's investigations of the velocity of sound."

Professor H. Croft, D.C.L., "On a reputed Blue Sand from India."

31ST MARCH.

G. R. R. Cockburn, M.A., "On Rent."

Professor J. B. Cherriman, M.A., "On a Problem in Substitutions."

Sandford Fleming, Esq., C.E., "On the development of lines of internal Communication, with a view to the future progress of Canada."

14TH APRIL.

Professor H. Y. Hind, M.A., "On the occurrence of Grasshoppers (so called) in the North-West."

Rev. Professor Hatch, M.A., Trinity College, "On the moral relations of the Greek Oracles."

The Council take this opportunity of urging upon Members the necessity of individual exertion and active co-operation with them, to render this portion of the Society's operations more efficient and successful,—many communications of value and interest, they are convinced, might be secured with a little attention on the part of Members.

It is unnecessary here to repeat what has been alluded to in former Reports of your Council, regarding the honourable position occupied by the *Journal* in Europe and the United States, as well as in this Province. The volume just completed, the Council feel persuaded, will further assist in maintaining its standing. The following is the Report of the Editing Committee:—

REPORT OF THE EDITING COMMITTEE.

In fulfilment of the usual observance, the Editing Committee of the *Canadian Journal* have herewith the honour to present their Annual Report to the Council of the Institute.

In the volume of the *Journal* just completed, the fifth of the New Series, the Committee have sought, to the best of their ability, to maintain and extend the Canadian character of this publication, as developed, under the auspices of Dr. Wilson and former committees, in the preceding volumes of the series. Thus, each number of the *Journal* issued during the present year, will be found to contain at least two, and in most instances, three or four, original communications on subjects exclusively Canadian; whilst in the department of Reviews, various works, emanating from the Provincial Press, have also been brought under notice. These articles, together with the contributions on other subjects, contained in the volume, will bear, it is thought, a not unfavourable comparison with the published communications of former years. The Committee, however, cannot refrain from an expression of regret, that so little has been done by the members at large towards the literary support of the *Journal*. In the volume just completed, for example, the first department, or that of Original Communications, has obtained but thirteen contributors; the department of Reviews, no more than three; and that of Literary and Scientific Notes, a scarcely greater number. Much labour

has thus necessarily fallen upon some two or three of the editorial staff. The Committee, therefore, would earnestly urge upon the Members in general, a request for more active co-operation, in enabling them to maintain unimpaired the favourable character and position now acquired by the *Journal* both in home and foreign circles.

No additional Societies have been placed on the exchange list since the date of the last Report; but the Committee have continued to receive, from time to time, valuable publications from those with which the Institute is already in correspondence. The titles of these corresponding Societies and Institutions,—amounting to fifty-four in number,—are given for the information of members, in the annexed classified view :—

Canada.

Literary Society, Quebec.
Natural History Society, Montreal.
Hamilton Association, C. W.

The United States.

Smithsonian Institution, Washington.
American Geographical and Statistical Society, New York.
Lyceum of Natural History, New York.
American Antiquarian Society, Boston.
Natural History Society, Boston.
Harvard University, Cambridge, Massachusetts.
Observatory, Cambridge, Mass.
Essex Institute, Salem, Mass.
Historical Society, Pennsylvania.
Academy of Sciences, Philadelphia.
Franklin Institute, Philadelphia.
Academy of Sciences, New Orleans.
Historical Society, Chicago, Illinois.
University Library, Michigan.
Academy of Sciences, St. Louis.

England.

Royal Society, London.
Royal Geographical Society, London.
Royal Geological Society, "
Royal Astronomical Society, "
Royal Society of Arts, "
Royal College of Surgeons, "
Society of Antiquaries, "
Linnæan Society, "
Chemical Society, "
Royal Society of Literature, London.
Institute of British Architects, "
Institute of Civil Engineers, "
Ethnological Society of London.
Archæological Institute, London.
British Archæological Institute, London.
Microscopical Society of London.
Athenæum Club, London.
Philosophical Society of Cambridge.
Society of Antiquaries of Newcastle-on-Tyne.

Scotland.

Royal Society of Edinburgh.
Royal Society of Arts, Edinburgh
Royal Physical Society, "
Royal Society of Antiquaries, Scotland.

Ireland.

Royal Irish Academy.
Royal Dublin Society.
Trinity College, Dublin.
Natural History Society of Dublin.
Geographical Society of Dublin.

British India.

Geological Survey of India, Calcutta.

France.

Imperial Library of France.
Geological Society of France.
Society of Antiquaries of France.

Denmark.	*Sweden and Norway.*
Royal Library of Copenhagen.	Royal Library of Stockholm.
Society of Antiquaries of the North Copenhagen.	University of Christiania.

Finally, the Committee beg to observe, that, the actual expense of publication, including engravings, has amounted, during the past year, to £275 16s.; a sum not in excess of the average annual expenditure in this department.

EDWARD J. CHAPMAN, *General Editor.*

The Report of our Treasurer, submitted herewith, shows the finances to be in a satisfactory state:—

STATEMENT OF THE CANADIAN INSTITUTE GENERAL ACCOUNT FOR 1860.

Debtor.	£	s.	d.
Cash—Balance from last year	602	4	5
" Received from Members	246	12	4
" " for Journals	62	7	10
" " for Interest on Loans	97	0	0
" Parliamentary Grant, 1860—*due*	250	0	0
" Due by Members	328	6	2
" Due for Sale of Journals—Old Series	22	1	3
" " " " New Series	51	6	3
	£1659	18	4

Creditor.	£	s.	d.
Cash paid on account of Journal, 1859	35	4	2½
" " " " 1860	156	6	0
" " " Library and Museum	85	6	11
" " " Sundries	336	10	2
" Due on account of Journal	149	10	1
" " of Sundries	80	9	10
" " of Library	13	17	7
Estimated balance in favour of Institute	852	12	6
	£1659	18	4

STATEMENT OF THE BUILDING FUND.

	£	s.	d.
Cash—Balance and Investments last year	1845	6	9
" Received for Interest on Loans	97	0	0
Subscription list	534	15	0
	£2477	1	9

THE TREASURER IN ACCOUNT WITH THE CANADIAN INSTITUTE.

Debtor.	£	s.	d.
Cash balance last year	602	4	5
Securities	1425	0	0
Interest received on Securities	97	0	0
Cash received from Members	246	12	4
" on account of Journals sold	62	7	10
	£2433	4	7
Credit.			
Cash paid for Journal, 1859	35	4	2½
" " 1860	156	6	0
" for Library and Museum	85	6	11
" on account of sundries	336	10	8
Securities	1425	0	0
Balance	394	17	2½
	£2433	4	7

D. CRAWFORD,
Treasurer.

TORONTO, 5th December, 1860.

Compared vouchers with cash-book, investment securities exhibited, and balance in hands of Treasurer, £394 17s. 3d.

(*Signed*) SAM. B. HARMAN, SAM. SPREULL, } *Auditors.*

On the occasion of the recent visit of the Prince of Wales to Toronto, the Council availed themselves of the opportunity, to present to His Royal Highness, a loyal address, which has already appeared in the Journal; but in order that a more permanent record of the matter may appear on the proceedings of the Society, the Council subjoin a copy of the address, and of the reply graciously made thereto.

To His Royal Highness, Albert Edward, Prince of Wales, K.G., &c. &c. &c.

MAY IT PLEASE YOUR ROYAL HIGHNESS,—The President, Council, and Members of the Canadian Institute, incorporated by Royal Charter for the promotion of Science and Literature in this province, humbly approach your Royal Highness with loyal and affectionate greetings; and tender to you, with unfeigned respect, their welcome on this auspicious occasion.

While the energies of this province are chiefly directed to the development of its vast agricultural capabilities, and to the fostering of trade and commerce, as the essential sources of its material prosperity, the Canadian Institute specially devotes itself to investigations and researches such as lead to the discovery of abstract truths in Science, but which ultimately tend to the intellectual and social

progress of man. While, therefore, uniting with their fellow subjects in this province of the Empire, in welcoming your Royal Highness with grateful and hearty loyalty, as the representative of their beloved Queen, and the heir apparent to the British Throne, they beg leave respectfully to tender their loyal congratulations unitedly as an Institute devoted to objects and pursuits specially fostered by Her Majesty's countenance, and to the furtherance of which the illustrious Prince Consort has extended his highest favour and influence.

Enjoying as they do all the priceless blessings derived from institutions by right of which Her Gracious Majesty rules over a free and united people; and sharing in the glories, and sympathising in all the interests of the empire, of which this province forms no unimportant member: they hail with loyal satisfaction the presence of your Royal Highness, on whom rest the future hopes of this Great Empire. Their earnest prayer is, that, endowed with all noblest graces and divine blessings, trained in sound learning, and gifted with a liberal love of Science and the Arts, you may be eminently fitted for the high trust of which you are the heir. May he who is the Kings of Kings, long spare to you, as to them, her who, while commanding honour from your filial heart, lives not less fondly in the affections of a willing people. On her sceptre, the virtues of their loved and gracious Queen have conferred a might more potent than ever ruler achieved by conquest. Under its genial sway, science and letters have accomplished triumphs which will render the Victorian era illustrious in all future ages; and while other nations are struggling to attain such privileges as her subjects freely enjoy, the British Empire—the sceptre of which they trust will hereafter be no less illustrious in your hands than in those of their beloved Queen,—has girdled the world with a glorious confederacy of provinces, alike united in freedom, in intellectual progress, and in loyal devotion to their Sovereign head.

In their united capacity, as an Institution incorporated by Royal Charter, and specially recognised by the Provincial Parliament as representatives of the interests of Science and Letters, the President, Council, and Members of the Canadian Institute renew their assurances of devoted loyalty to Her Gracious Majesty, and of cordial welcome to your Royal Highness.

D. WILSON, LL.D., *President.*

Toronto, September 8th, 1860.

SIR,—I have the honour to convey the thanks of His Royal Highness the Prince of Wales, for the address presented to him by the President, Council, and Members of the Canadian Institute.

I have the honour to be,
Sir,
Your obedient servant,
NEWCASTLE.

DANIEL WILSON, Esq., LL.D.,
&c., &c., &c.,
President.

In the last Annual Report allusion was made to the expediency of changing the name of the Institute, a subject first brought under the notice of members during the session of 1858–9. The Council have not during the session further moved

in the matter; they however think the question one of great importance to the Society, and trust it will not be lost sight of, as they fear the causes which appeared to render such a change desirable have not been removed.

Though the progress of the Society during the past year has not been so great as in some former years, or as its previous history might seem to warrant, it has, nevertheless, been on the whole satisfactory. It must not be forgotten that the Province is only beginning to recover from a state of unprecedented depression, which materially affected societies like the Canadian Institute. The Council cherish the hope that returning prosperity may have the effect of producing new activity and vigour among members, and that the session now opening may prove to be far in advance of any previous one in everything that pertains to its true and best interests.

D. WILSON,
President.

APPENDIX.

BOOKS PURCHASED.

	VOLS.
Encyclopædia Britannica. 8th edition. Vols. 19 and 20	2
Geological Survey of Canada, Sir W. Logan, F.R.S., Director.—Figures and descriptions of organic remains: Decade 1, " 3, " 4	3
Maclear's Almanac for 1860	1
My Diary in India in the year 1858-59. By W. Howard Russell, LL.D., special correspondent of the *Times*. In two vols. 1 and 2	2
The Voyage of the *Fox* in the Arctic Seas. McClintock, (a narrative of the fate of Sir John Franklin, &c	1
The Origin of Species by means of Natural Selection, &c., &c. By Charles Darwin, M.A., &c	1
The Complete Writings of Thomas Say. On the Entomology of North America, &c. Edited by John L. LeConte, M.D. Vols. 1 and 2	2
——— Conchology	1
Hayes' Arctic Boat Voyages	1
Geology and Mineralogy considered with reference to Natural Theology. By the late Very Rev. William Buckland, D.D., &c., Dean of Westminster. Vols. 1 and 2. Bridgewater Treatise	2
History of the Conquest of Peru. By William H. Prescott. In two vols. Vols. 1 and 2	2
The Institutions of the Mind inductively investigated. By Rev. James McCosh, LL.D	1
Micrographic Dictionary. Griffith and Henfrey	1
Outlines of Astronomy. Sir John Herschell	1
British Diatomaceæ. Smith. Vols. 1 and 2	2

	VOLS.
Journal of the Royal Geographical Society. Vols. 27 and 28............	2
The Permanent Way and Coal Burning Locomotive Boilers of European Railways..	1
Voyage of the *Barracouta* to Japan, Kamtschatka, Siberia, China, etc. By J. M. Tronson, R. N., 1859..	1
Story of New Zealand. Thomson. Vols. 1 and 2.........................	2
Stephen's Central America. Vols. 1 and 2.............................	2
——— Yucatan. Vols. 1 and 2..	2
Collection of Rare and Original Documents and Relations concerning the Discovery and Conquest of America. No. 1. By E. G. Squire, M A., F.S.A..	1
The recent Foraminifera of Great Britain. By W. Crawford Williamson, F.R.S., Prof. of Natural History, Owen's College, Manchester, 1858....	1
Kitchi-Gami Wanderings round Lake Superior. By J. G. Kohl. Chapman and Hall..	1
History of Canada from the time of its Discovery till the Union year (1840-1.) Translated from "L'Histoire du Canada" of F. X. Garneau, Esq., and accompanied with illustrative notes, &c. By Andrew Bell. 3 vols....	3
Total..	39

DONATIONS OF BOOKS, &c.

From T. C. WALLBRIDGE, ESQ.

The Poetical Works of James Hoskins, A.B., M.B., Trinity College, Dublin. Edited by H. T. Baldwin, A.M., of Osgoode Hall, U. C., Barrister at Law.	1

From REV. DR. RYERSON, SUPERINTENDENT OF EDUCATION, *Upper Canada*.

Annual Report Normal, Model, Grammar, and Common Schools U. C., for 1858, with appendix..	2

From the PUBLISHER.

Archaia. By J. W. Dawson, LL.D., F.G.S., &c..........................	1
Report on the Exploration of the Country between Lake Superior and the Red River Settlement, and between the latter place and the Assiniboine and Saskatchewan. By S. J. Dawson, Esq., C.E....................	1
North West Territory.—Report on the Assiniboine and Saskatchewan Exploring Expedition. By Henry Youle Hind, M.A...................	1

From the AMERICAN GEOGRAPHICAL AND STATISTICAL SOCIETY, *New York*.

Bulletin. Vol. I. (3 Nos.)..	1
——— Vol. II..	1
Journal. Vol. I, (10 parts)...	1
Johnson's Railroad to the Pacific. 8vo..................................	1
Criminal Statistics of New York, 1854. 8vo.............................	1
Hewitt on Iron...	1

	VOLS.
De la Roquette on Keilhau..	1
Report of Council for 1857	1
First Annual Report of the Cooper Union, for the advancement of Science and Art. 1st January, 1860..	2

From the AUTHOR.

Course of Practical Chemistry as adopted at University College, Toronto. By Prof. H. Croft, D.C.L.F.C.S., Prof. of Chemistry, University College	1

From the HON. J. M. BRODHEAD, *Washington.*

Explorations for a Railroad Route from the Mississippi River, to the Pacific. Vols. 10. 11..	2
Patent Office Reports, 1859 :—Agriculture..............................	1
Compulsory Enlistment of American Citizens............................	1
Messages and Documents, 1859-60:—Abridged in one Volume............	1
Commerce and Navigation, 1859..	1
Report of the Finances, 1858-59..	1

From MAJOR LACHLAN, *Cincinnati.*

Meteorologische Waarnamingen in Nederland en Zijne Besittingen, en af wijkengen van Temperatuur en Baromterstand op vele plaatsen in Europa Uitgiven door het Roninklijk Nederlandsch Meteorologische Instituut, 1856 & 1857.—*Quarto*....................................	2
The 4th Meteorological Report of Professor James P. Espy, (Quarto) to the United States Government, 27th July, 1854..........................	1
Cotton is King, and Pro-Slavery arguments, comprising the writings of Hammond, Harper, Christy, Stringfellow, Hodge, Bledsoe and Cartwright.—Published and sold exclusively by subscription, 1860................	1

From the HON. G. W. ALLAN, M.L.C., *Toronto.*

A monogram of the Trochilidæ. Parts, 17 & 18..........................	2

Presented Anonymously.

Hume's History of England in 5 Vols., full Bound in Calf, Illustrated year 1793..	5
Picture frame—For Lithograph of St. Helena. Presented by Colonel J. H. Lefroy, Royal Artillery..	1

From the HISTORICAL SOCIETY *of Pennsylvania.*

The Record of the Court at Upland, in Pennsylvania, 1676 to 1681. And a Military Journal kept by Major E. Denny, 1781 to 1795..............	1

From J. H. JAMES, ESQ., *per* DOCTOR PHILBRICK, *Yorkville.*

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Forhandlinger ved de Skandinaviske, &c. 1 Christiania—Den 12-18 Juli 1856.	1
Generalberentning fra Gaustad Sindssygeasyl for Aaret, 1858..............	1
Tale Cantate ved det Norske Universitets Meredefest for Kong Oscar......	1

	VOLS.
Uïber die Geometrische Reprä-sentation &c., Von O. A. Bjerkness & Dor O. J. Broch, Profr.	1
Karlamagnus Saga ok kappa Hans. 1	1
Al-Mufassal. Edidit J. P. Broch	1
Det Kongelige Norske Fredericks Universitets Aars beretning for Aaret 1856—1858	1
Traces de Buddhisme en Norvegé avant l'introduction du Christianisme. Par M. C. A. Holmboe	1
Beretning om en Zoologiske Reise foretagen i Sommeren 1857 ved D. C. Danielssen	1
Fortegnelfe over Modeller of Laudhusholdnings-Redskaber &c. &c.	1
Personalier oplæste ved Hans Majestæt Kong Oscar den 1st.	1
Beretning om Godsfæng slets Verksomhed i aaret 1858	1
Total	12

From the SECRETARY OF STATE *for India.*

Bombay Magnetical and Meteorological observations, 1857	1

From the GEOLOGICAL SURVEY OF INDIA, *Calcutta.*

Memoirs of the Survey.	Vol. 1.	Part 1, with map			1
Do	do	"	Part 3,	do	1
Do	do	" 1.	Part 1,	do	1
Annual Report	do		1858–59		1

From the UNITED STATES COAST SURVEY, *Washington, U. S.*

Report of the Superintendent,—Progress of the Survey, 1858	1

From H. G. Bohn, Esq., *London.*

THE ILLUSTRATED LIBRARY.

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Gil Blas, Illustrated by Smirke and Cruikshank. Translated by Tobias Smollett	1
The Mission, or scenes in Africa, by Captain Marryatt, R.N.	1
Recreations in shooting. By Craven, New Edition	1
Evenings at Haddon Hall, &c. Illustrated by G. Cattermole	1
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	VOLS.
Morphy's Games of Chess, by J. Lowenthal, &c. &c.	1
Carpenter's Animal Physiology	1
Index of dates. By J. Willoughby Rosse, Vol. 2, K.—Z.	1

THE HISTORICAL LIBRARY.

Diary and Correspondence of John Evelyn, F.R.S., from the original MSS., at Wotton, by W. Bray. Vols. 1, 2, 3, 4	4
Memorial of John Hampden his party and times, by Lord Nugent, 4th Edition: 1860	1

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The formation and progress of the Tiers Etat in France, by Augustin Thierry. Translated by Rev. F. B. Wells. 2 Vols. in one	1
Lectures on the History of Literature ancient and modern, from the German of Frederick Schlegel with a General Index	1

COLLEGIATE SERIES.

Novum Testamentum Græcum and Lexicon	1

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The Trilogy or Dante's Three Visions, Inferno or the Vision of Hell, by the Rev. John Wesley Thomas, 1859	1
The Life of Samuel Johnson, LL.D., by James Boswell, Esq., 40 engravings on Steel, 1859, 8 Vols. 1, 2, 3, 4, 5, 6, 7, 8	8
Johnsoniana, Vol. 1, or Vol. 9 of Boswell's Johnson	1
" Vol. 2, or Vol. 10. "	1
Life of George Washington, by Washington Irving, Vol. V. conclusion with General Index	1
The Convalescent, his rambles and adventures, by N. Parker Wills, 1859 ...	1
Lowndes' Bibliographers' Manual	
" Vol. 2, Part 2	1
" Vol. 3, Part 1	1
Total	38

From Rev. H. Scadding, D.D., *Toronto.*

Voyages from Montreal on the River St. Lawrence, through the Continent of North America to the frozen ocean, &c., 1789 and 1793, with maps. By Alexander Mackenzie, Esq	1
Grafton's Chronicle: or History of England, to which is added his table of the Bailiffs, Sheriffs, and Mayors of the city of London, from the year 1189 to 1558 inclusive, in 2 Vols. Vols. 1 and 2	2
A German and Russian Dictionary with Explanations in French. Printed at Moscow, 1796	1

From the SMITHSONIAN INSTITUTION, *Washington, U. S.*

The Smithsonian Contributions to Knowledge. Vol. XI. 1859	1

From PATRICK MCGREGOR, ESQ., *Toronto.*	VOLS.
The General Grievances and oppression of the Isles of Orkney and Shetland. By Mr. James Mackenzie, writer, Edinburgh, 1836	1
Sacontala eller den Uheldidge ring et Indiansk Drama af Cálidás oversat af original Sprogene Sanscrit og Pracrit i Engelsk og heraf i Dansk med en Indledning til den Danske oversættelse Kiöbenhavn, 1793	1
From the CLERK OF THE HOUSE OF ASSEMBLY.	
Statutes of the Province of Canada for year 1860	1
Appendix 36 to 38. Vol. 17. No. 5—1859	1
" 36 " " No. 4—1859	1
Annual Report of Normal, Model, Grammar, and Model Schools, U. C.	1
From LEONARD SCOTT & CO., *New York.*	
Edinburgh, Westminster, North British, and London Quarterly Reviews; and Blackwood's Magazine for 1860	
From B. QUARITCH, *London.*	
Catalogue Raisonné of Rare Valuable and Curious Books	1
From JAMES HODGES, ESQ., *Victoria Bridge per* B. DAWSON.	
Construction of the Great Victoria Bridge in Canada, by James Hodges, Engineer to Messrs. Peto, Brassey and Betts, Contractors. 2 vols. 1 Construction. 1 Plates	2
From the ROYAL SOCIETY, *London, per* SMITHSONIAN INSTITUTE, *Washington, U. S.*	
Observations made at the Magnetical and Meteorological Observatory at St. Helena, with discussions of the observations at St. Helena, the Cape of Good Hope, the Falkland Islands, Carlton Fort in North America and Pekin, &c. Vol. II. London, 1860	1
The Royal Society's List of Members, 30th Nov	1
The Oceanic Hydrozoa, &c., by Thomas Henry Huxley, F.R.S., F.L.S. &c.	1
From the SOCIETY OF ANTIQUARIES *of the North, Copenhagen.*	
The Northmen in Scotland. Société Royale des Antiquaries du Nord. Séance Annuelle de Mai, 1569	1
Royal Society Northern Antiquaries of Copenhagen (sheets)	2
Cabinettet for Americanske Oldsager, Pages 9—16	1
Membres Fondateurs (sheets)	2
From the HISTORICAL SOCIETY *of Chicago.*	
Catalogue of the 1st Exhibition of Statuary and Painting, 1859	1
Minutes of the General Association of Illinois	1
Fourth Annual Report of the officers of the Reform School, 1859	1
School Law, Free Schools in the State of Illinois, 1859	1
City Comptrollers 3rd Annual Report, 1859—1860	1
Illinois Baptist Anniversaries, 1859	1
Second Annual Report of the Chicago Eye and Ear Infirmary for year ending May 1st, 1860	1

From DOCTOR HAYDEN, *Albany*.	VOLS.
Maps of the Nebraska Territory	2
From ALFRED BRUNEL, ESQ.	
Report of the City Engineer, Toronto, for 1860	1
Annual Report of the Receipts and Expenditure of the City of Toronto, for the year ending the 31st December, 1859	1
From SUPERINTENDENT OF EDUCATION, *Lower Canada*.	
Reports for year 1858	2
From the UNIVERSITY OF HAVARD COLLEGE.	
Report of the Committee of Overseers, 1859	1
Catalogue of the Officers and Students, year 1860—61, first term	1
From PROF. J. M. DAWSON, L.L.D., F.G.S. *Montreal*.	
Supplementary Chapter to Acadian Geology	1
Vegetable Structures in Coal	1
On the Silurian and Devonian Rocks of Nova Scotia	1
Fossils in Coal	1
From the WILMINGTON INSTITUTE, *Delaware*.	
Catalogue of the Phænogamous and Filicoid Plants of Newcastle County, Delaware	1
From R. HOE & Co.	
Hoe's Catalogue of Printing Apparatus	1
From PROFESSOR H. Y. HIND, M.A.	
Maps of the Assiniboine and Saskatchewan Exploring Expedition	6
In exchange for JOURNAL,	
The Journal of Education for Upper Canada, 1860	1
The Journal of the Franklin Institute, Philadelphia, 1860	1
The Artizan, London, 1860	1
The Journal of the Society of Arts, London, Duplicate, 1860	1
Silliman's American Journal, 1860	1
Canadian Naturalist and Geologist, 1860	1
Proceedings of the Boston Natural History Society, 1860	1
Journal of Education, Lower Canada, 1860	1
Journal de l'Instruction Publique, Lower Canada, 1860	1
The Atlantis, 1860	1
Journal of the Gelogical Society of Dublin. Pages 95—185	1
Journal of the Royal Dublin Society, "Arctic Ice Travel," by Capt. McClintock, R.N.	1
Proceedings of the Academy of Natural Sciences of Philadelphia. Pages 1—48 and 81—412	1
Transactions of the Royal Scottish Society of Arts. Vol. V., Part III	1

	VOLS.
Journal of the American Geological and Statistical Society. Vol. II., No 1. July, 1860	1
Journal of the Board of Agriculture, Upper Canada, 1860	1

ANNALES DES MINES, &c., *France.*

Tome XV.	1st Livraison	1859	1
"	2nd "	"	1
"	3rd "	"	1
XVI	4th "	"	1
"	5th "	"	1
"	6th "	"	1
XVII	1st "	"	1

Essex Institute, Historical Recollections of. Vol. II., No. 1. February, 1860. No. 2—April—No. 3 June—No. 4 August—No. 5 October	5
The Weal-Reaf, a Record of the Essex Institute Fair, Nos	7
Transactions of the Academy of Sciences, St. Louis. Vol, 1—No. 4	1

DONATIONS TO THE MUSEUM.

From JOHN FLEMING, ESQ.

A collection of Trilobites and other Geological Specimens from Collingwood, Canada West.

BOOKS BOUND FROM PERIODICALS RECEIVED.

Journal of the Franklin Institute, 1859	2
Journal of Education, Lower Canada, 1857 and 1858	1
Illustrated London News, 1859	2
Hunt's Merchants' Magazine, 1858. July to December	1
" do " 1857	2
Silliman's American Journal, July—Nov., 1858	1
Canadian Merchants' Magazine. Vol. 4, January—June, 1859	1
Journal of the Society of Arts, Nov., 1858—Nov., 1859	1
The Artizan, 1859	2
The Art Journal, 1859	1
Quarterly Journal Geological Society. Vols. 10, 11, 12, 13 and 14	5
Quarterly Journal of Microscopical Science. Vols. 1, 2, 3, 4 and 7	5
The London, Edinburgh and Dublin Philosophical Magazine. Vols. 11, 12, 13, 14, 15 and 16	6
The Edinburgh New Philosophical Magazine. Vols. 2, 3, 4, 5, 7, 8, 9, 10	8
The Chemical Gazette. Vols. 5, 6, 7, 8 and 9	5
The Canadian Naturalist and Geologist. Vols. 2, 3 and 4	3
The Civil Engineer and Architects' Journal, 1859	1
Journal of the Chemical Society. Vols. 7, 8, 9, 10, 11 and 12	6
The Mining Journal, 1859	1
The Athenæum, 1859	2

CANADIAN INSTITUTE.

SESSION—1860-61.

THIRD ORDINARY MEETING—*12th January*, 1861.

Professor DANIEL WILSON, LL.D., President, in the Chair.

I. *The following donations for the Library were announced, and the thanks of the Institute voted to the donors:*

For the Library.

1. From the Hon. Sir J. B. Robinson, Bart.
   Natural History of the United States of America, by Louis Agassiz. Vol. 3.
2. From France.
   Annales des Mines, &c., Tome XVII. 2nd Livraison de 1860.

II. *The following Gentlemen were elected Members:*

Col. EARDLY WILMOT, Royal Artillery, Montreal.
S. G. WOOD, Esq., Toronto.

III. *The following Papers were read:*

1. By the President:
   "The Annual Address."
2. By W. Arnold, Esq.:
   "On an Inconvertible Paper Currency for Canada."

FOURTH ORDINARY MEETING—*19th January*, 1861.

Professor W. HINCKS, F.L.S., 1st Vice-President, in the Chair.

I. *The following Gentlemen were elected Members:*

JOHN BOYD, Esq., Toronto.
JAMES DYKES CAMPBELL, Esq., Toronto.
L. B. HALL, Esq., M.D., Toronto.
S. T. ABBOTT EVANS, Esq., P.L.S., Bristol, C.E.

II. *The following Papers were read:*

1. By P. Freeland, Esq.:
   "On the movements of the Diatomaceæ, with illustrations of living specimens under the microscope."
2. By A. E. Williamson, Esq.:
   "On some fresh water Mollusca collected in the neighbourhood of Toronto."

FIFTH ORDINARY MEETING—*26th January*, 1861.

Professor DANIEL WILSON, LL.D., President, in the Chair.

I. *The following Papers were read:*

1. By J. F. Smith, Junr., Esq.:
   "On a new species of Triarthrus."
2. By the Rev. Prof. W. Hincks, F.L.S.:
   "On some additions to the Flora of Toronto, observed during the past year."

MEAN METEOROLOGICAL RESULTS AT TORONTO FOR THE YEAR 1860.

BY PROFESSOR KINGSTON, M.A., DIRECTOR OF THE OBSERVATORY, TORONTO.

Read before the Canadian Institute 16th February, 1861.

Temperature.—The mean temperature of the year 1860 was 44.°32, a number exceeding by 0.°20 the average of 21 years. This small excess was due to the mildness generally of the Spring and Autumn, since the means of both the Summer and Winter months were mostly below the average. The average of the differences, without regard to signs of the monthly means from their respective normals, was 1.°98 for the year 1860, and 2.°42 for the period 1853–60. As far as this can be taken as a test, 1860, in respect to temperature, may be regarded as approximately a normal year.

The range of the year, the mean of the monthly ranges, and the mean of the daily ranges, were respectively 96.°5, 45°93, and 14.°24; which, compared with 108.°11, 48.°08, and 16.°41, the corresponding numbers for the period 1853–60, indicate a general moderation in the fluctuations of temperature.

The warmest day was July 19, with a mean of 75°0, and the coldest, December 14, when the mean was 1.°08. The extremes of temperature for the year (88.°0 and − 8.°5) occurred on July 19 and February 1. The former was 2.°4 below, and the latter 3.°2 above, the averages of the yearly maxima and minima.

There were 32 days in which the mean of the day differed from the normal by 12° and upwards. Of these none occurred in the summer months, but were distributed through the rest of the year in a tolerably regular progression, their frequency increasing with a decreasing temperature, and reaching a maximum in February. In grouping together the four years terminating with 1860, a well-marked double progression becomes apparent with a second or inferior maximum in June. If regard be had, not to the *number* of abnormal daily means but to the *amount* of abnormal variation of each observation, without reference to any arbitary limit, it will be found that the aggregate of these variations in the several months derived from a series of six years conform to a double progression, similar to that above described, the principal maximum of mean abnormal variation 10.°1 occurring in February; the two minima, 5.°1 and 4.°5, in May and August; and the second maximum, 5.°7, in June, the mean for the whole year being 6.°7.

Barometer.—It will be seen from the table that the mean height of the barometer for the year differed from the average by —.0276 inches, an unusually large difference as compared with other years. The mean of the monthly differences from their respective averages, and without regard to sign, was small, being only ·0449 inches against ·0509 inches, the corresponding number for the period 1855–60.

The extremes of pressure were within narrow limits as regards their amount, and were separated by an interval of only 138 hours, the maximum, 30·267 inches, having occurred on December 14 at 5 P.M., and the minimum, 28·838 inches, on December 20 at 11 A.M.

The days of excessive abnormal variation, in which the mean pressure of the day differed by ·200 inches, and upwards, from the normal, were 115, a number somewhat larger than usual. The law of their distribution among the months is not so well marked as in the case of temperature, but their greater frequency in the winter than in the summer months is sufficiently obvious, being 19 and 5 in December and August of 1860, and on the aggregate of four years, 50 in December and 17 in August. If further the aggregate amounts of the abnormal variations of all the observations in each month be compared, a law will be found to prevail in the distribution resembling very closely in its general character that just stated.

Humidity.—The mean humidity of the year was 77, which is rather in excess of that of the preceding year. Its distribution among the several months was more than usually equable.

Clouds.—The extent of sky clouded, in accordance with the experience of former years, amounted to $\frac{3}{5}$ of the hemisphere on the average of the year. July and August were the clearest months, and December the most cloudy.

Wind.—The resultant direction of the wind was N. 60 W., (almost identical with that of 1859) and the resultant velocity 8·32 miles. The mean velocity was 8·55 miles, which shows a still further increase on the velocity of the preceding year. The day of greatest wind was March 21, when the velocity averaged 28·83 miles; and the calmest day was February 4, when the mean velocity was only 0·85 miles per hour. The greatest velocity recorded for a whole hour was 40·6 miles, from 8 P.M. to 9 P.M. on February 9.

The most windy hours on the average of the year were from 1 P.M. to 2 P.M., and from 2 P.M. to 3 P.M., with a mean velocity in each case of 11·17 miles; and the calmest hour from 1 A.M. to 2 A.M., when the mean velocity was 6·91 miles.

Rain and Snow.—The depth of rain was 23·434 inches, or nearly 10 inches less than in 1859, a deficiency having occurred in every month but February, July and August. The amount of snow (45·6 inches) was also below the average to the extent of 15·3 inches, and the rain and melted snow combined fell short of the average by 8·589 inches. While the quantity of rain and snow was deficient the number of days on which rain fell was about 8 per cent., the number of days of snow 2 per cent., and the number of rain or snow about 5 per cent., greater than the average of the six years given in the annexed table.

July was the most rainy month in respect to the amount of rain, and May in respect to its frequency. Even when snow is taken into account and reckoned as rain, July still maintains its predominance in the amount of precipitation, but the maximum of frequency is then transferred to December.

The heaviest fall of rain was 1·265 inches on December 19, and the heaviest fall of snow 9 inches on February 18.

Thunderstorms.—Of the 31 thunderstorms recorded the earliest took place on February 22, and the latest on October 15. The storm of August 24 was one of great violence.

Auroras.—Of the 58 auroras given in the table the most brilliant occurred on March 26, 27, and September 6 and 15.

The following is the General Meteorological Abstract for the year 1860, deduced from the observations taken at the Provincial Observatory:—

GENERAL METEOROLOGICAL

Provincial Magnetical Observatory,

LATITUDE, 43° 39'.4 North. LONGITUDE, 5 h. 17 m. 33 s. West. ELEVATION ABOVE

	Jan.	Feb.	March.	April.	May.	June.
Mean Temperature	23.38°	22.83°	34.48°	39.55°	55.53°	[illegible]
Difference from average (21 years)	− 0.32	0.00	+ 4.19	− 1.38	+ 3.95	+ 1.[illegible]
Thermic Anomaly (Lat. 43° 40' N.)	− 9.42	−11.87	− 5.62	−10.65	− 2.57	− 1.44
Highest Temperature	46.4	50.2	67.0	61.8	74.5	81.6
Lowest Temperature	− 6.8	− 8.5	12.8	19.5	32.5	49.2
Monthly and Annual Ranges	53.2	58.7	54.2	42.3	42.0	32.4
Mean Maximum Temperature	29.83	29.43	41.89	47.04	63.97	72.58
Mean Minimum Temperature	17.58	15.32	27.35	32.19	47.79	55.34
Mean Daily Range	12.25	14.11	14.54	14.84	16.18	17.24
Greatest Daily Range	30. 5	26.5	30.1	25.6	24.6	26.9
Mean Height of Barometer	29.6429	29.6324	29.5111	29.5775	29.5[illegible]	29.4[illegible]
Difference from average (13 years)	+.0131	+.0199	— 1203	—.0296	—.0176	—.[illegible]
Highest Barometer	30.142	30.136	29.934	30.265	29.886	[illegible]
Lowest Barometer	29.156	28.920	29.044	28.896	29.088	[illegible]
Monthly and Annual Ranges	0.987	1.216	0.890	1.369	0.798	[illegible]
Mean Humidity of the Air	.81	.81	.71	.74	.76	.71
Mean Elasticity of Aqueous Vapour	.110	.112	.148	.185	.338	.414
Mean of Cloudiness	0.71	0.67	0.49	0.59	0.57	0.58
Resultant Direction of the Wind	N 89 W	N 61 W	N 64 W	N 37 W	N 26 E	N 44 W
Resultant Velocity of the Wind	6.09	3.28	7.61	4.10	2.66	3.13
Mean Velocity (Miles per hour)	9.37	8.73	12.41	10.30	7.17	7.61
Difference from average (13 years)	+1.62	+0.85	+3.97	+2.51	+0.75	+2.40
Total Amount of Rain (in inches)	0.740	1.330	0.882	1.282	1.815	2.136
Difference from average (20 and 21 years)	—0.703	+0.273	—0.637	—1.153	—1.419	—1.012
Number of Days Rain	6	7	5	11	16	14
Total Amount of Snow (in inches)	8.7	18.8	2.4	0.3	0.0	...
Difference from average (18 years)	— 4.54	+1.42	—6.47	—1.96	—0.08	...
Number of Days Snow	16	13	11	5	0	...
Number of Fair Days	11	11	17	15	15	16
Number of Auroras observed	5	2	12	7	7	2
Possible to see Aurora (No. of Nights)	16	11	19	18	19	17
Number of Thunderstorms	0	1	0	1	8	5

* In this table the averages with which the yearly means of temperature, the velocity of pared, all include 1880. In former tables the back years given for comparison were each

REGISTER FOR THE YEAR 1860.

Toronto, Canada West.

LAKE ONTARIO, 108 feet. APPROXIMATE ELEVATION ABOVE THE SEA, 342 feet.

July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year 1860.	Year 1859.	Year 1858.	Year 1857.	Year 1856.	Year 1855.
63.93° − 2.90 − 4.78	64.46° − 1.59 − 4.04	55.34° − 2.51 − 6.16	47.25° + 1.88 − 6.55	37.95° + 1.28 − 5.25	24.00° − 1.88 −12.00	44.32° + 0.20 − 6.68	44.19° + 0.07 − 6.81	44.74° + 0.62 − 6.26	42.73° − 1.39 − 8.27	42.16° − 1.96 − 8.84	43.96° −0.16* −7.02
88.0 43.8 44.2	87.0 46.8 40.2	75.8 28.7 47.1	68.0 28.4 39.6	64.5 13.2 51.3	39.0 − 7.0 46.0	88.0 − 8.5 96.5	88.0 −26.5 114.5	90.2 − 7.3 97.5	88.2 −20.1 108.3	96.6 −18.7 115.3	92.8 −25.4 118.2
72.99 55.85 17.15 30.7	73.73 56.27 17.46 24.4	63.12 47.29 15.83 28.2	53.65 41.58 12.06 23.2	43.23 33.53 9.70 25.0	28.79 19.25 9.54 23.5	14.24 30.7	13.66 39.8	13.84 31.2	16.38 37.0	18.29 44.2	18.19 39.4
29.5640 −.0583	29.5825 −.0536	29.6733 +.0192	29.6711 +.0318	29.5226 −.0962	29.6666 +.0203	29.5923 −.0276	29.6209 +.0010	29.6267 +.0068	29.6054 −.0145	29.5999 −.0200	29.6249 +.0050
29.839 29.157 0.682	29.903 29.211 0.692	30.170 29.233 0.937	29.982 29.019 0.963	29.959 28.844 1.115	30.267 28.838 1.429	30.267 28.838 1.429	30.392 28.286 2.106	30.408 28.849 1.559	30.361 28.452 1.909	30.480 28.459 2.021	30.552 28.459 2.093
.72	.76	.74	.81	.80	.84	.77	.74	.73	.79	.75	.77
.427	.463	.342	.272	.195	.115	.260	.249	.259	.254	.244	.263
0.43	0.43	0.48	0.70	0.70	0.83	0.60	0.61	0.60	0.60	0.57	.60
N 69 W 2.15 7.29 +2.36	N 70 W 1.83 5.80 +0.56	N 71 W 2.63 5.79 +0.35	N 9 W 2.00 6.93 +1.08	S 89 W 4.95 11.02 +3.52	N 62 W 4.66 10.14 +1.94	N 60 W 3.32 8.55 +1.83	N 61 W 2.24 8.17 +1.45	N 41 W 1.59 7.64 +0.92	N 74 W 2.54 7.99 +1.27	N 71 W 3.03 8.31 +1.59	N 62 W 2.51 8.14 +1.42*
4.336 +0.806 13	3.405 +0.455 14	1.969 −2.032 14	1.618 −0.892 15	2.569 −0.513 12	1.362 −0.232 3	23.434 −7.059 130	33.274 +2.781 127	28.051 −2.442 131	33.205 +2.712 134	21.505 −8.968 99	31.650 +1.157* 103
... ...	... ...	... ...	Inapp. −0.88 1	1.9 −1.19 8	13.5 −1.60 21	45.6 −15.30 75	64.9 + 4.00 87	45.4 −15.50 67	73.8 +12.90 79	65.5 + 4.60 69	99.0 +28.10* 64
18	17	16	15	15	8	174	169	178	171	198	198
6 19	8 19	6 22	0 10	1 12	2 8	58 190	53 199	59 198	26 189	35 212	46 204
4	9	2	0	0	0	31	30	19	28	25	38

the wind, and the yearly amount of rain and snow, for each of the years 1855—1860 are com-
referred to the average including itself, but no subsequent year.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—DECEMBER, 1860.

Latitude—43 *deg.* 39.4 *min. North.* *Longitude*—5 *h.* 17 *m.* 33 *s. West.* *Elevation above Lake Ontario,* 108 *feet.*

Day.	Barom. at temp. of 32°. 6 A.M.	2 P.M.	10 P.M.	Mean.	Temp. of the Air. 6 A.M	2 P.M	10 P.M	ME'N	Excess of mean above Average	Tens. of Vapour. 6 A.M	2 P.M.	10 P.M.	M'N
1	29.198	29.221	29.291	29.2417	22.6°	23.7°	24.1°	23.28°	− 7.50°	.096	.105	.100	.101
2	.322	.376	—	—	24.1	29.5	—	—	—	.107	.144	—	—
3	.545	.576	.598	.5747	29.5	32.7	31.3	31.22	+ 1.05	.150	.165	.166	.155
4	.542	.483	.446	.4878	28.0	29.8	28.0	28.38	− 1.40	.131	.140	.131	.135
5	.410	.387	.410	.4017	23.0	24.8	23.0	23.70	− 5.55	.106	.126	.113	.115
6	.348	.261	.310	.3075	25.9	28.8	24.1	26.25	− 2.82	.120	.144	.120	.129
7	.385	.575	.702	.5738	29.1	35.6	27.7	30.32	+ 1.65	.148	.142	.142	.139
8	.756	.852	.920	.8517	25.2	25.9	24.1	24.92	− 3.55	.115	.120	.107	.117
9	.890	.856	—	—	29.8	35.2	—	—	—	.147	.165	—	—
10	.363	.070	.297	.2387	31.6	33.4	29.5	31.20	+ 3.35	.170	.187	.144	.165
11	.427	.605	.480	.5007	23.3	19.7	21.2	20.75	− 6.90	.093	.064	.099	.084
12	.155	.166	.168	.1737	27.3	26.2	24.8	25.20	− 2.15	.139	.090	.112	.108
13	.335	.524	.812	.5805	17.6	15.4	4.2	11.25	−15.90	.088	.059	.047	.063
14	30.090	30.233	30.216	30.1893	−6.6	8.2	1.3	1.08	−25.88	.029	.040	.043	.037
15	30.114	29.968	29.902	29.9892	6.7	19.6	12.5	13.20	−13.57	.052	.065	.067	.061
16	29.725	.827	—	—	23.7	31.6	—	—	—	.118	.156	—	—
17	.984	30.045	30.087	30.0488	25.5	25.0	22.3	23.98	− 2.38	.125	.109	.092	.105
18	30.130	30.091	29.905	30.0290	24.8	25.0	27.0	24.92	− 1.25	.112	.109	.136	.119
19	29.687	29.414	.234	29.4345	33.4	36.0	36.7	35.45	+ 9.38	.171	.196	.213	.196
20	28.895	28.900	.157	28.9973	37.8	38.5	34.9	37.05	+11.17	.217	.174	.145	.178
21	29.343	29.287	.099	29.2355	29.1	30.2	27.7	28.27	+ 2.48	.141	.128	.142	.136
22	.215	.461	.698	.4902	24.1	24.2	17.2	21.15	− 4.53	.114	.099	.075	.094
23	.780	.816	—	—	10.7	21.9	—	—	—	.059	.097	—	—
24	.950	.990	.932	.9605	17.6	24.4	13.6	18.30	− 7.18	.083	.106	.067	.084
25	.844	.791	—	—	20.1	23.7	—	—	—	.098	.112	—	—
26	.972	30.051	30.116	30.0577	20.8	27.3	25.9	23.88	− 1.42	.097	.111	.128	.110
27	30.172	30.163	30.215	30.1888	24.1	28.8	25.1	25.80	+ 0.52	.114	.137	.116	.121
28	30.225	30.183	30.110	30.1697	18.3	25.2	19.7	21.70	− 3.45	.080	.115	.096	.101
29	29.986	29.964	29.820	29.8797	28.0	32.0	32.7	31.03	+ 5.87	.131	.143	.173	.150
30	.870	.899	—	—	24.4	19.0	—	—	—	.096	.067	—	—
31	30.009	30.076	30.010	30.0617	16.1	20.5	16.9	17.82	− 7.37	.081	.070	.077	.076
M	29.6530	29.6578	29.6774	29.6666	23.31	26.44	23.02	24.00	− 3.09	.116	.118	.114	.115

Day.	Humidity of Air. 6 A.M	2 P.M.	10 P.M.	M'N	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Resul't. Direction.	Velocity of Wind. 6 A.M.	2 P.M.	10 P.M.	Result'.	ME'N	Rain in inches.	Snow in inches.
1	.79	.82	.77	.81	NW b N	N W	NW b W	N 53° W	13.0	21.0	22.0	20.47	20.73	...	0.1
2	.82	.87	—	—	W N W	W N W	W N W	N 75 W	19.0	21.5	9.0	14.65	14.79	...	Inp.
3	.92	.88	.95	.88	W	W	W	N 78 W	6.2	11.0	6.5	5.24	6.76	...	Inp.
4	.86	.84	.86	.87	N b E	N b E	N N W	N 6 W	9.5	10.0	5.8	7.69	7.89	...	0.1
5	.86	.94	.92	.90	N	N W	W N W	N 53 W	8.8	5.7	0.5	5.86	6.35	...	Inp
6	.86	.89	.93	.90	W b S	S W b S	W S W	S 44 W	4.0	18.2	1.0	6.04	6.36	...	1.0
7	.92	.68	.94	.83	W S W	W b N	N N W	N 31 W	5.0	10.2	4.5	4.96	8.53	...	...
8	.85	.86	.82	.87	NE b N	N b E	NW b N	N 1 W	11.8	2.7	2.5	3.60	5.83	...	...
9	.88	.81	—	—	W S W	W	Calm.	S 68 W	9.0	8.2	0.0	2.95	5.56	...	1.5
10	.96	.98	.87	.94	E b S	N b E	NW b N	N 20 W	11.0	6.0	14.0	6.93	9.57	...	4.5
11	.73	.61	.87	.74	NW b N	W b N	W S W	S 82 W	17.0	12.5	11.7	11.37	14.18	...	Inp
12	.94	.62	.84	.79	W S W	W S W	SW b W	S 69 W	18.2	17.2	20.8	18.75	19.04	...	0.2
13	.92	.66	.89	.84	W b S	W N W	W N W	N 68 W	18.8	26.0	3.0	11.73	12.75	...	0.1
14	.89	.63	.91	.79	N b W	N N W	N b W	N 8 W	4.0	3.0	6.5	5.30	5.63	...	0.2
15	.88	.62	.88	.78	N N W	E S E	E N E	N 56 E	7.8	9.0	6.5	1.45	6.18	...	...
16	.93	.87	—	—	W S W	S W b W	W S W	S 60 W	14.5	14.5	1.5	8.47	8.52	...	...
17	.91	.81	.77	.81	W S W	N b E	N E b N	N 28 E	6.5	1.0	7.0	6.89	7.89	...	Inp.
18	.84	.81	.93	.87	E b N	E N E	E N E	N 75 E	14.0	19.5	21.5	17.45	17.70	...	0.5
19	.89	.93	.98	.95	E	E	E	S 84 E	14.5	12.0	7.0	8.78	8.98	1.265	...
20	.96	.74	.71	.80	E	W	W	S 89 W	7.4	19.0	14.8	11.05	13.23	0.047	...
21	.87	.76	.94	.87	W b N	NW b W	N N E	N 9 W	8.2	2.2	14.7	8.34	10.17	...	5.0
22	.87	.76	.78	.82	N W	W b S	W	N 86 W	17.0	18.2	5.0	10.02	10.48	...	Inp.
23	.82	.82	—	—	W	W b N	W b N	N 82 W	2.8	3.5	4.5	5.58	5.59	...	...
24	.85	.81	.83	.84	W b N	W b N	N N W	N 61 W	5.6	9.0	6.0	6.49	7.12	...	...
25	.91	.87	—	—	N	N N W	N N W	N 16 W	9.5	9.0	9.0	9.55	9.74	...	Inp.
26	.86	.74	.91	.85	N N W	N W	NW b N	N 42 W	3.0	18.0	12.0	10.23	10.27	...	Inp.
27	.87	.86	.86	.86	N W	N W	N b W	N 37 W	8.4	13.5	5.0	7.80	8.28	...	...
28	.81	.85	.91	.86	N b E	E	N E	N 66 E	5.0	9.4	9.8	9.15	10.64	...	...
29	.86	.79	.92	.86	E	E S E	S b W	S 20 E	15.0	11.7	15.0	9.21	13.64	0.050	0.2
30	.73	.64	—	—	S W	W S W	W b S	S 73 W	13.1	10.0	10.5	10.79	11.01	...	Inp.
31	.90	.64	.83	.79	W S W	S W b S	W S W	S 66 W	10.5	8.0	7.2	10.91	11.05	...	0.1
M	.88	.78	.87	.84	....	....	....	....	10.26	11.64	8.54	......	10.14	1.362	13.5

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR DECEMBER, 1860.

Highest Barometer . . . . 30.267 at 5 p. m. on 14th. } Monthly range=
Lowest Barometer . . . . 28.838 at 11 a. m. on 20th, } 1.4[illegible]9 inches.

Self-registering Thermometers.
Maximum temperature . . . . 39°0 on p.m. of 20th } Monthly range=
Minimum temperature . . . . —7°0 on a.m. of 14th } 46°0
Mean maximum temperature . . 28°79 } Mean daily range = 9°54.
Mean minimum temperature . . 19°25 }
Greatest daily range . . . . . . 23°5 from a. m. to p. m. of 16th.
Least daily range . . . . 2.8 from a. m. to p. m. of 10th.

Warmest day . . 20th ... Mean Temperature . . .=37°05 } Difference=35°97.
Coldest day . . . 14th ... Mean Temperature . . .= 1°08 }
Maximum Radiation { Solar . . . . 53°0 on p. m. of 7th } Monthly range=
{ Terrestrial . . . . —17.0 on a. m. of 14th } 70°0.

Aurora observed on 2 nights, viz.: on the 10th and 15th; possible to see Aurora on 8 nights; impossible on 23 nights.

Snowing on 21 days: depth, 13.5 inches; duration of fall, 68.4 hours.

Raining on 3 days; depth, 1.362 inches; duration of fall, 24.0 hours.

Mean of cloudiness=0.83; most cloudy hour observed, 8 a. m., mean=0.89: least cloudy hour observed, 10 p. m.; mean=0.75.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
2703.93	1065.97	1355.05	4411.21

Resultant direction, N 62° W; Resultant Velocity, 4.66 miles per hour.
Mean velocity 10.14 miles per hour.
Maximum velocity . . . 29.5 miles, from 7 to 8 a.m. on the 22nd.
Most windy day . . 1st —Mean velocity, 20.73 miles per hour. } Difference 15.17
Least windy day . . 9th —Mean velocity, 5.56 do } miles.
Most windy hour, 1 to 2 p. m.—Mean velocity, 11.94 miles per hour. } Difference
Least windy hour, 9 to 10 p m....—Mean velocity, 8.52 do. } 3.42 miles.

1st. Stormy day. Very high wind.—10th. Heavy snow storm from 4 to 7 p. m.—15th. Brilliantly colored aurora; very perfect arch and streamers 7 p. m. to midnight.—19th. Greatest day's rain during the year.—20th. Dense wetting fog from 6 to 11 a. m.—21st. Heavy snow storm from 2.30 p. m. to 1 a. m. of 22nd.—24th. Lunar halo from 5 p. m. to midnight.—26th. Solar halo at 9 a. m.—30th. Faint solar halo at 2.30 p. m.

Rapid Barometric movements.

Ascent { From 12th, at 6 a. m.=29.155
{ To 14th, at 5 p. m. =30.267

Range in 59 hours=1.112

Descent { From 18th, at 8 a. m. =30.130
{ To 20th, at 11 a. m. =28.838

Range in 51 hours=1.292

The Resultant Direction and Velocity of the Wind, for the month of December, from 1848 to 1860 inclusive, were respectively N. 69° W., and 2.93 miles.

The meteorological elements for December, 1860, differed from their respective averages as follows:—Temperature —1°88; Rain —0.232 inches; Snow —1.60 inches; Wind +1.94 miles per hour, and clouds +0,07.
The month was therefore comparatively cold, dry, windy, and very cloudy.

COMPARATIVE TABLE FOR DECEMBER.

YEAR.	TEMPERATURE. Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	RAIN. No. of days.	Inches.	SNOW. No. of days.	Inches.	WIND. Resultant Direction.	Resultant Velocity.	Mean Velocity
	°	°	°	°	°					°		
1840	24.3	— 1.6	41.0	— 4.4	45.4	3	inap.	18	...	...	...	...
1841	23.7	+ 2.8	45.5	+ 2.4	43.1	7	6.600	5	...	...	...	1.33 lbs.
1842	24.7	— 1.2	40.3	+ 3.8	36.5	3	0.880	17	...	...	...	0.61 "
1843	30.0	+ 4.1	41.1	+ 2.7	38.4	6	1.040	8	8.1	...	...	0.53 "
1844	28.2	+ 2.3	48.9	— 0.8	49.7	6	imp.	6	4.2	...	...	0.40 "
1845	21.1	— 4.8	37.6	— 2.7	40.3	2	inap.	12	4.7	...	...	0.70 "
1846	27.5	+ 1.6	49.2	+ 3.7	45.5	5	1.215	9	6.0	...	...	0.57 "
1847	30.1	+ 4.2	50.0	+ 6.6	43.4	7	1 185	8	6.8	...	...	0.35 "
1848	29.1	+ 3.2	49.1	+ 0.6	48.5	7	2.750	7	16.5	S 83 W	1.12	5.44ms.
1849	26.5	+ 0.6	41.3	— 5.2	46.5	5	0.840	12	9.6	N 82 W	2.56	6.23 "
1850	21.7	— 4.2	48.3	— 9.7	58.0	2	0.190	18	29.5	N 44 W	2.93	7.40 "
1851	21.5	— 4.4	43.8	—10.5	54.3	6	1.075	15	10.7	N 82 W	4.00	7.37 "
1852	31.9	+ 6.0	51.0	+13.9	37.1	7	3.995	10	20.1	S 69 W	1.03	6.54 "
1853	25.3	— 0.6	42.2	— 5.2	47.4	4	0.625	13	22.3	N 35 W	2.39	4.98 "
1854	21.9	— 4.0	41.8	— 5.9	47.7	6	0.590	12	17.2	N 44 W	4.30	8.56 "
1855	26.8	+ 0.9	45.9	— 2.1	48.0	6	1.845	10	29.5	S 88 W	5.29	11.38 "
1856	22.9	— 3.0	41.2	— 9.1	50.3	6	1.790	20	16.3	S 87 W	4.62	11.56 "
1857	31.9	+ 6.0	45.6	+ 5.7	39.9	7	3.205	14	9.0	N 89 W	2.51	6.84 "
1858	27.4	+ 1.5	43.6	+ 5.0	38.6	11	1.657	18	10.4	N 18 W	1.66	9.36 "
1859	17.9	— 8.0	54.8	— 3.3	58.1	3	1.035	23	37.4	N 53 W	4 29	10.77 "
1860	24.0	— 1.9	38.5	— 7.0	45.5	3	1.362	21	13.5	N 62 W	4.66	10.14 "
Mean	25.88	...	44.80	—1.02	45.82	5.3	1.594	13.1	15.10	...	...	8.20

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY TORONTO, CANADA WEST—JANUARY, 1861.

Latitude—43 deg. 39.4 min. North. Longitude—5 h. 17 min. 33 sec. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M	2 P.M	10 P.M	ME'N		6 A.M	2 P.M	10 P.M.	M'N	6 A.M	2 P.M	10 P.M	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M	2 P.M	10 P.M	Resul't.	ME'N		
1	29.768	29.807	29.763	29.7815	25.5°	29.8°	27.7°	27.60°	+ 2.38°	.104	.096	.128	.109	.75	.58	.84	.72	S W	SW b W	W S W	S 62° W	24.0	8.0	6.5	8.50	8.88	...	...
2	.716	.710	.686	.7080	26.2	32.0	28.0	28.75	+ 3.55	.124	.158	.139	.140	.87	.87	.90	.88	S W b W	SW b W	N	N 29 W	3.5	6.5	8.0	2.45	7.03	...	...
3	.678	.619	.617	.6350	16.9	17.6	11.1	15.12	—10.03	.084	.076	.063	.075	.90	.79	.87	.86	N	N N W	N N W	N 17 W	7.8	9.5	6.2	8.15	8.33	...	Inp.
4	.663	.715	.709	.7027	11.4	18.8	21.9	17.17	— 7.97	.068	.081	.105	.081	.94	.79	.89	.84	N W b N	W N W	SW b W	S 71 W	5.5	7.0	12.5	9.91	11.13	...	Inp.
5	.846	.825	.871	.8543	14.0	19.4	23.0	19.08	— 6.05	.074	.080	.106	.089	.91	.77	.86	.85	S W b W	SW b W	W S W	S 66 W	15.2	13.0	11.4	9.68	9.96	...	Inp.
6	.880	.711	—	—	21.9	28.4	—	—	—	.105	.134	—	—	.89	.86	—	—	W b S	S E b S	N E	S 81 E	1.5	7.0	5.0	3.74	5.35	...	1.0
7	.346	.301	.565	.4170	29.1	23.0	17.2	23.00	— 2.13	.148	.120	.087	.118	.92	.97	.91	.94	E b N	N E b N	N N W	N 21 E	9.5	8.5	3.5	5.66	7.63	0.050	3.0
8	.675	.719	.733	.7165	19.0	23.7	21.9	21.42	— 3.72	.098	.112	.105	.103	.95	.87	.89	.90	N N W	N W b N	N W b N	N 12 W	2.0	3.5	1.5	3.03	3.20	...	0.5
9	.604	.405	.285	.4185	19.7	24.4	22.6	22.43	— 2.70	.096	.110	.111	.107	.91	.84	.99	.89	N N E	N E	N W b N	N 12 E	7.5	5.5	3.6	3.89	6.21	...	0.1
10	.203	.377	.713	.4553	22.3	15.8	0.6	11.63	—13.42	.116	.065	.040	.071	.96	.74	.88	.87	W S W	N W b N	W	N 47 W	6.5	26.0	5.5	12.42	13.83	...	Inp.
11	.731	.568	.500	.6010	—4.4	1.5	3.9	0.12	—24.93	.033	.046	.051	.043	.90	.97	.97	.94	N N E	N E b N	N N E	N 18 E	6.0	16.2	13.8	11.87	12.71	...	4.0
12	.657	.934	30.059	.9045	—1.9	—3.4	—6.6	-4.15	—29.23	.039	.030	.026	.032	.97	.83	.80	.89	N	N N W	N N W	N 16 W	13.0	7.5	7.6	7.16	7.25	...	...
13	30.125	30.079	—	—	—1.2	14.0	—	—	—	.039	.074	—	—	.94	.90	—	—	N b W	S b E	N E b N	N 64 E	7.2	5.0	6.5	1.93	4.78	...	Inp.
14	29.830	29.632	29.669	.7180	12.2	27.3	26.2	22.67	— 2.43	.069	.126	.139	.113	.89	.84	.98	.90	N N E	E N E	N N E	N 38 E	9.0	7.5	7.8	5.86	6.55	...	Inp.
15	.646	.567	.478	.5512	26.2	28.4	27.7	27.38	+ 2.28	.139	.134	.142	.140	.98	.86	.94	.94	N N E	E N E	E N E	N 63 E	7.2	14.2	13.0	13.75	13.86	0.140	Inp.
16	.132	.022	.203	.1162	29.8	33.8	34.2	32.53	+ 7.53	.162	.190	.196	.181	.98	.98	.99	.98	E N E	N b W	S b W	S 10 E	22.0	7.8	13.2	1.25	11.19	0.475	Inp.
17	.506	.710	.842	.7027	29.5	26.2	24.8	26.60	+ 1.58	.150	.124	.120	.128	.92	.87	.90	.88	W b N	W b N	N W	N 49 W	11.0	9.8	4.0	6.29	7.53	...	Inp.
18	.744	.364	.204	.4153	28.0	28.0	28.4	28.02	+ 3.05	.139	.146	.148	.145	.90	.95	.95	.94	E b N	N E b N	N N W	N 39 E	11.0	14.5	0.5	4.41	12.37	...	3.0
19	.282	.352	.416	.3595	32.0	31.6	27.3	29.88	+ 5.00	.166	.156	.118	.147	.91	.87	.79	.87	S S W	S b W	S S W	S 16 W	16.6	14.5	17.5	16.31	16.42	...	0.1
20	.491	.631	—	—	21.9	22.6	—	—	—	.113	.107	—	—	.96	.87	—	—	W b N	W S W	W b N	N 85 W	14.5	8.5	12.0	7.55	7.62	...	0.1
21	.813	.941	30.075	.9563	7.1	20.8	10.7	12.45	—12.33	.053	.083	.059	.066	.88	.75	.82	.85	W	SW b W	W	S 73 W	3.5	13.8	2.0	5.21	5.44	...	...
22	30.199	30.279	30.316	30.2722	—0.1	15.4	7.8	7.47	—17.30	.037	.077	.056	.055	.85	.87	.91	.86	W	W	W	N 70 W	2.0	0.5	5.4	2.60	2.73	..	...
23	30.324	30.223	30.041	30.1757	10.0	24.6	27.7	21.52	— 3.15	.059	.094	.135	.109	.87	.71	.89	.83	—	—	E b S	—	7.6	16.0	17.5	—	14.40	...	1.0
24	29.725	29.422	29.452	29.5305	28.0	32.4	32.4	30.38	+ 5.82	.146	.184	.169	.161	.95	.100	.91	.95	E b S	E b S	SW b W	S 5 W	18.2	10.5	19.5	5.06	15.37	0.020	6.0
25	.610	.651	.807	.6985	15.1	22.3	12.2	15.03	— 9.55	.074	.079	.059	.067	.86	.66	.78	.75	SW b W	W S W	W S W	S 65 W	14.8	15.5	1.5	9.81	9.88	...	...
26	.873	.806	.735	.7957	1.7	20.1	11.1	11.25	—13.23	.038	.091	.060	.065	.80	.85	.83	.85	W	W b S	N W	N 77 W	6.5	0.5	3.0	2.95	3.25	...	...
27	.661	.506	—	—	14.3	29.1	—	—	—	.071	.126	—	—	.85	.78	—	—	N N W	S b E	SW b W	S 32 W	1.0	10.5	8.0	6.[illegible]7	7.66	...	0.2
28	.553	.619	.563	.5837	22.6	28.0	25.1	25.37	+ 1.07	.103	.109	.123	.112	.85	.71	.91	.82	W S W	SW b W	S b W	S 33 W	7.8	13.5	4.8	9.07	10.45	...	1.2
29	.309	.195	.262	.2602	29.5	34.5	21.9	28.45	+ 4.25	.158	.181	.106	.146	.97	.90	.90	.91	S b E	S W	W b S	S 75 W	6.6	11.8	14.0	13.97	15.21	...	0.4
30	.439	.594	.754	.6143	15.0	24.8	19.7	19.35	— 4.75	.082	.120	.090	.093	.95	.90	.84	.87	W b S	W b S	W S W	S 71 W	21.5	17.2	9.5	13.24	14.10	...	Inp.
31	.731	.648	.587	.6527	15.0	16.5	16.1	15.75	— 8.23	.075	.076	.081	.078	.87	.83	.90	.88	SW b W	W S W	W S W	S 60 W	15.5	12.0	6.6	7.80	7.83	...	...
M	29.6520	29.6298	29.6631	29.6517	17.78	22.86	19.43	19.86	— 4.94	.098	.109	.102	.102	.90	.84	.89	.88	....	....	....	....	9.85	10.38	8.11	......	9.30	0.685	20.0

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR JANUARY, 1861.

Highest Barometer .... 30.330 at 7 p. m., on 22nd } Monthly range=
Lowest Barometer .... 29.006 at 1 p.m., on 16th } 1.324 inches.

Self-registering Thermometers.
Maximum Temperature .... 37°0 on p. m. of 18th } Monthly range=
Minimum Temperature ....—11°2 on p. m. of 12th } 48°2
Mean maximum Temperature .... 25°14 } Mean daily range=
Mean minimum Temperature .... 13°93 } 11°21
Greatest daily range .... 25°2 from a. m. to p. m. of 13th.
Least daily range.................. 2°0 from a. m. to p. m. of 3rd.

Warmest day......... 16th... Mean temperature......... 32.53 } Difference = 36°68.
Coldest day......... .. 12th... Mean temperature.........—4°15 }

Maximum { Solar.................................. 54°0 on p. m. of 29th } Monthly range=
Radiation. { Terrestrial..........................—18°5 on p. m. of 12th } 72°5.

Aurora observed on 0 nights,
Possible to see Aurora on 9 nights; impossible on 22 nights.
Snowing on 23 days; depth 20.6 inches; duration of fall 93.6 hours.
Raining on 4 days,—depth 0.685 inches; duration of fall 14.5 hours.
Mean of cloudiness = 0.76. Above average .05.
Most cloudy hour observed, 8 a. m., mean = 0.85; least cloudy hour observed, 10 p. m., mean, = 0.66.

Sums of the components of the Atmospheric Current, expressed in miles.

North.	South.	East.	West.
2054.34	1913.15	1168.42	3271.01

Resultant direction N. 86° W.; Resultant velocity 2.92 miles per hour.
Mean velocity.......................... 9.30 miles per hour.
Maximum velocity .... 26.8 miles, from 10 to 11 a. m. on 10th.
Most windy day .... 19th......Mean velocity 16.42 miles per hour. } Difference=
Least windy day .... 22nd......Mean velocity 2.73 ditto. } 13.69 miles.
Most windy hour...11 a.m. to noon............Mean velocity 10.87 ditto. } Difference =
Least windy hour... 7 to 8 p. m. ....Mean velocity 7.96 ditto. } 2.91 miles.

1st. Lunar Halo at 6 a. m.—11th and 12th. Very cold and stormy days.—16th. Dense fog 4 to 6 p. m.—20th. Very distinct lunar halo at 6 p. m.—23rd. Well defined solar halo at 2 p. m.—23rd. Very perfect lunar halo from 5.30 to 11 p. m.—24th. Dense fog 2 to 4 p. m.—26th. Faint lunar halo at 11 p. m.—31st. Solar halo from 3 p. m.

Great Barometric ranges. { 13th, 6 a. m. = 30.125 / 16th, 1 p. m. = 29.006 } Descent in 79 hours = 1.119.

Ditto. { 18th, midn't. = 29.190 / 22nd, 7 p. m. = 30.330 } Ascent in 91 hours = 1.140.

The Resultant Direction and Velocity of the Wind for the month of January, from 1848 to 1861 inclusive, were respectively N. 77 W. and 2.98 miles.

The Direction Shaft of the Anemometer was out of order on the 23rd, the Resultant Direction and Velocity of the Wind for that day are consequently imperfect.

COMPARATIVE TABLE FOR JANUARY.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	No. of days.	Inch's.	No. of days.	Inch's.	Resultant Direction.	Resultant V'y.	Mean Force or Velocity.
1840	° 17.0	° —6.5	° 40.6	° —13.8	° 54.4	4	1.395	11	...	...	...	....
1841	25.6	+2.1	41.7	— 4.1	45.8	2	2.150	14	...	...	...	0 36 lbs.
1842	27.9	+4.4	45.8	1.3	44 5	5	2.170	9	...	...	...	0.78
1843	28.7	+5.2	54.4	1.5	52.9	6	4.295	12	14.2	...	...	0.69
1844	20.2	—3.3	44.6	— 7.7	52.3	7	3.005	11	24.9	...	...	0.70
1845	26.5	+3.0	43.0	— 3.4	46 4	5	Imp.	9	22.7	...	...	0.70
1846	26.7	+3.2	41.2	0.3	40.9	5	2.335	10	6.0	...	...	0.55
1847	23.3	—0.2	42.6	— 2.2	44.8	7	2.135	5	7.5	...	...	1.09 mls.
1848	28.7	+5.2	51.5	—12.0	63.5	7	2.245	8	7.1	N 82° W	2.03	5.82
1849	18.5	—5.0	40.1	—15.2	55.3	4	1.175	10	9.2	N 63° W	3.06	6.71
1850	29.7	+6.2	46.3	10.6	35.7	5	1.250	8	5.2	N 37° W	0.69	5.89
1851	25.5	+2.0	43.2	—12.8	56.0	4	1.275	10	7.8	S 77° W	3.26	7.69
1852	18.4	—5.1	37.3	— 7.0	44.3	0	0.000	19	30.9	N 68° W	3.14	7.67
1853	23.0	—0.5	40.9	— 6.6	47.5	1	0.290	6	7.5	N 27° W	2.52	6.34
1854	23.6	+0.1	45.2	— 4.3	49.5	7	1.270	11	7.5	N 77° W	2.44	6.91
1855	25.9	+2.4	48.2	— 4.7	52.9	5	0.525	13	23.3	N 73° W	1.91	7.26
1856	16.0	—7.5	33.1	—12.1	45.2	0	0.000	14	13.6	N 75° W	5.24	10.69
1857	12.8	-10.7	34.6	—20.1	54.7	3	Inp.	16	21.8	N 70° W	4.96	10.31
1858	30.0	+6.5	45.8	7.5	38.3	6	1.152	11	4.0	N 71° W	2.33	7.40
1859	26.4	+2.9	41 5	—26.5	68.0	6	1.449	19	16.4	S 81° W	3.17	8.76
1860	23 4	—0.1	45.4	— 5.1	50.5	6	0 740	16	8.7	N 89° W	6.09	9.37
1861	19.9	—3.7	34.5	— 7.0	41.5	4	0.685	23	20.6	N 86° W	2.92	9.30
M	23.53	...	42.80	—6.52	49.31	4.5	1.407	12.0	13.63	....	...	7.86 Ml.
Diff. from av'g	-3.67	...	-8.30	—0.48	-7.81	-0.5	-0.722	+ 11.0	+ 6.97	....	...	+ 1.44

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—DECEMBER, 1860.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M.D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.			Tension of Vapour.			Humidity of Air.			Direction of Wind.			Horizon'l Movem't in 24 hrs. In miles.	Mean of Ozone. (tenths)	Rain in Inches.	Snow in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	9 A.M.	2 P.M.	10 P.M.					6 A.M.	2 P.M.	10 P.M.
1	29.914	29.173	29.174	30.1	31.7	26.0	.148	.140	.115	.89	.84	.87	W N W	W S W	W S W	299.04	4.0	...	1.10	Cu. Str. 10	Snow.	Snow.
2	202	259	425	24.2	28.2	27.3	111	135	127	86	85	87	W	W b S	W b S	299.30	3.0	...	1.58	Do. 10	Cu. Str. 10.	Cu. Str. 10.
3	552	741	756	26.1	32.1	30.0	123	143	155	87	79	92	W b S	S b W	W	248.00	3.5	...	...	Do. 8	Do. 4.	Do. 10.
4	817	704	736	26.1	28.2	25.5	115	129	117	83	82	87	N E b E	N E b E	N E b E	106.44	3.0	...	...	Do. 10	C. C. Str. 4.	Do. 10.
5	579	498	582	23.0	27.2	21.3	106	111	090	86	75	78	N W b N	S	W b N	287.30	3.5	...	...	Do. 10	Cu. Str. 10.	Do. 10.
6	558	572	674	14.1	21.5	13.8	067	090	063	81	75	82	W b N	E S E	S E b E	59.30	4.0	...	...	C. C. Str. 6.	Do. 10.	Clear.
7	745	819	714	18.2	20.2	12.6	082	075	060	84	70	80	N E b E	N E b E	S b E	45.40	2.5	...	Inap.	Cu. Str. 10.	C. C. Str. 4.	Cu. Str. 10.
8	479	30.050	934	14.0	34.2	13.9	067	034	059	81	73	75	N E b E	S S W	S E	35.30	2.5	...	...	Do. 10.	Cu. Str. 4.	Clear. Zod. lt.
9	30.076	29.800	30.137	15.4	30.0	17.4	070	136	072	82	81	76	S S W	W S W	W S W	42.90	2.0	...	...	C. C. Str. 4.	Do. 2.	Do. A. B. & Z.l.
10	29.918	504	29.400	8.8	17.5	21.1	060	078	085	86	83	78	N E b E	N b W	N E b E	243.50	3.5	...	3 31	Snow.	Snow.	Snow.
11	562	679	782	20.1	15.5	8.8	091	061	042	85	78	73	N N W	W N W	W N W	228.31	2.5	...	0.27	Do.	Cu. Str. 10.	Clear.
12	514	302	476	10.4	14.6	11.6	054	061	051	78	73	70	S S W	W S W	E S E	97.20	2.5	...	0.75	Cu. Str. 10.	Snow.	Cu. Str. 4.
13	373	635	889	9.4	9.0	1.0	051	042	034	78	76	80	W S W	W	W S W	66.70	2.0	...	...	C. C. Str. 4.	C. C. Str. 2.	Clear.
14	30.203	30.346	30.510	10.0	0.0	7.5	016	030	325	60	69	80	W	W	W	0.10	2.5	...	...	Clear.	Clear.	Do.
15	451	411	392	− 8.1	6.0	− 3.0	020	035	052	60	61	80	N E b E	N E b E	S W b S	17.30	2.0	...	...	Cu. Str. 10.	Do.	Cu. Str. 10.
16	097	29.969	056	−11.8	13.0	16.2	020	054	074	76	71	83	N E b E	S S W	S W b S	25.80	2.0	...	...	C. C. Str. 2.	C. Cum. 2.	Do. 10.
17	259	30 265	378	6.2	9.5	2.3	047	080	040	86	76	85	W	S S W	S S W	172.50	2.0	...	...	C. Str. 8.	Clear.	C.C. Str. 2. Z.l.
18	507	545	649	− 6.0	3.0	− 8.9	028	028	024	81	58	79	N E b E	N E b E	N E b E	88.60	2.0	...	...	Clear.	Do.	Clear. Zod. lt.
19	389	209	226	− 9.0	4.0	20.1	023	038	091	77	78	85	N E b E	N E b E	E b S	169.10	3.0	...	4.40	C. C. Str. 10	Snow.	Cu. Str. 10.
20	204	30.109	132	32.4	34.0	19.0	175	183	142	94	90	88	E b S	N E b E	N E b E	214.20	5.0	0.714	2.18	Rain.	Do.	Nimb. 10.
21	29.594	551	29.645	26.1	22.3	12.9	123	084	054	87	71	71	W S W	W S W	W	140.51	3.0	...	...	Cu. Str. 10.	Cu. Str. 10.	Clear.
22	483	29.802	845	19.0	31.2	19.1	087	149	087	84	84	84	N E b E	N E b E	W b S	113.10	4.8	...	3.20	Suow.	Snow.	Cu. Str. 10.
23	996	30.029	30.104	6.0	19.7	7.2	043	081	045	73	77	76	S W	W S W	W S W	88.90	2.0	...	...	Clear.	Clear.	Clear.
24	30.116	30.048	178	2.0	17.2	11.6	034	063	057	71	67	79	W S W	W	W	248.40	2.0	...	...	Cu. Str. 4.	Do.	Cir. Str 4.L.H.
25	154	083	089	9.2	19.8	13.1	051	081	088	77	78	92	W	S S W	S W	43.60	2.5	...	Inap.	C. C. Str. 10.	Snow.	Cu. Str. 10.
26	253	248	242	14.2	29.9	23.9	067	123	100	81	77	79	S W	S W	W S W	34.50	2.5	...	Inap	Do. 10.	Do.	Do. 10.
27	317	301	424	19.1	25.4	17.8	087	111	072	84	81	75	W S W	W S W	W S W	7.60	2.0	...	...	Do. 10.	Cu. Str. 10.	Do. 10.
28	468	415	503	17.3	28.4	18.9	074	129	077	77	82	76	W S W	W S W	S b W	5.80	2.0	...	...	Do. 10.	Do. 10.	Hazy.
29	510	344	328	16.1	19.3	16.8	074	071	070	83	69	80	N E b E	N E b E	N E b E	60.40	2.5	...	...	Do, 10.	Do. 10.	Clear. Zod. lt.
30	323	272	220	17.0	31.2	31.4	078	155	185	83	89	89	N E b E	S E b E	S S E	102.09	4.5	...	4.80	Snow.	Snow.	Cu. Str. 10.
31	259	240	268	19.1	24.1	20.9	[illegible]	100	088	84	79	78	W S W	W S W	S W	257.50	4.5	...	...	Cu. Str. 10.	Cir. Cul. 4.	Do. 10.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—JANUARY, 1861.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M.D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.—F.			Tension of Vapour.			Humidity of Air.			Direction of Wind.			Horizontal Movement in Miles in 24 hours.	Mean of Ozone. t'nths	Rain in inches.	Snow in inches.	Weather, &c. A Cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A. M.	2 P. M.	10 P. M.	6 A. M.	2 P. M.	10 P. M.	6 A. M.	2 P. M.	10 P. M.	6 A. M.	2 P. M.	10 P. M.	6 A. M.	2 P. M.	10 P. M.					6 A. M.	2 P. M.	10 P. M.
1	30.071	29.981	30.058	21.4	28.0	19.8	.096	.117	.081	.85	.76	.77	s w	w s w	N b E	168.30	5.0	...	0.70	Snow.	Cu. Str. 6.	Fog.
2	29.850	901	065	19.4	31.8	13.8	097	149	057	92	84	72	s w	N w	N E	228.90	4.0	...	...	Cu. Str. 10.	Str. 10.	Cu. Str. 10.
3	151	30.087	29.913	1.0	7.3	7.3	036	040	045	84	67	76	N E b E	N E b E	N N E	286.20	3.0	...	0.50	Do. 10.	Cu. Str. 10.	Do. 10.
4	000	29.954	30.009	8.4	16.1	2.5	064	061	042	88	73	86	w s w	w s w	w s w	97.20	3.5	...	...	Do. 10.	Clear.	Cl. Zo.L. A.B.
5	29.985	30.027	024	10.5	26.0	22.7	059	111	095	89	81	79	s b w	w s w	w b s	184.40	2.0	...	...	Do. 10.	Cu. Str. 10.	Cu. Str. 10.
6	30.299	147	075	11.0	10.6	7.3	062	059	045	89	89	78	w	w N w	w N w	136.50	5.0	...	0.57	C. C. St. 9.	Do. 10.	Do. 10.
7	29.878	29.805	29.898	4.6	10.6	7.4	046	048	051	87	69	87	N E b E	N E b E	N E b E	446.50	3.0	0.100	1.10	Cu. Str. 10.	Snow.	Rain & Sleet.
8	30.066	30.076	30.065	5.0	24.1	20.0	041	094	081	74	73	77	N	w s w	w s w	199.60	3.5	...	...	Do. 10.	C. C. Str. 4.	C. C. Str. 4.
9	055	29.928	29.855	— 5.0	4.0	1.5	029	030	081	81	59	70	N b w	N E b E	N E b E	82.90	5.0	...	...	Do. 10.	Cu. Str. 2.	Cir. Str. 10.
10	29.540	337	552	2.7	19.0	5.0	040	077	032	84	76	14	N b E	w	w	239.20	3.5	...	0.75	Do. 10.	Snow.	Cl. Zo. L. A. B.
11	980	978	30.075	23.0	—10.6	—20.6	004	015	032	25	55	33	w	w s w	s w b s	245.50	3.0	...	...	Clear.	Clear.	Clear. Zod. L.
12	30.096	30.191	204	—34.7	— 5.1	—17.9	002	026	006	22	70	40	w	s s w	s s w	27.20	2.0	...	...	Do.	Do.	Do. do.
13	473	563	555	26.6	1.6	—16.9	008	029	008	37	56	71	s E b E	s w b s	s s E	17.20	2.0	...	...	Do.	Do.	Do. do.
14	337	245	080	13.8	6.4	3.0	018	049	015	74	87	72	N E b E	s	N E b E	74.70	3.0	...	...	Cu. Str. 10.	Cu. Str. 4.	Cu. Str. 10.
15	077	29.940	040	7.0	21.7	20.0	045	090	036	76	78	84	N E b E	N E b E	N b E	169.90	5.0	...	...	Do. 10.	Do. 10.	Do. 8.
16	29.891	674	29.552	22.3	24.2	14.8	101	085	082	86	79	87	N E b E	N b E	N E b 1	363.90	5.5	...	5.46	Do. 10.	Snow.	Snow.
17	759	959	30.107	16.0	17.0	5.0	074	078	078	83	83	74	N E b E	N E b E	N E b E	164.70	5.5	...	...	Do. 10.	Clear.	Clear. Zod.Lt.
18	30.130	30.080	29.750	— 2.0	6.8	8.7	030	043	042	80	75	79	N E b E	N b E	N E b E	139.20	4.0	...	...	Clear.	Cu. Str. 10.	Cu. Str. 10.
19	29.600	29.550	728	12.2	18.9	15.3	063	077	052	81	76	82	N E b E	N E b E	N E b E	998.10	5.5	...	11.15	Snow.	Snow.	Snow.
20	680	674	810	13.1	19.9	10.0	063	077	070	81	76	68	w s w	N N w	w s w	103.20	5.0	...	...	Clear.	Clear.	Cu. Str. 10.
21	900	958	30.080	5.1	14.7	11.1	041	061	045	74	73	79	w b s	w	w	372.80	2.5	...	...	Cu. Str. 4.	Cu. Str. 10.	Do. 10.
22	30.317	30.359	520	4.3	17.4	5.6	036	072	057	73	76	73	w	w s w	w s w	574.40	2.0	...	...	C. C. Str. 6.	Clear.	Clear.
23	620	626	687	—16.1	9.6	— 4.6	009	045	038	43	68	82	w b s	s b w	s	111.90	2.5	...	..	Clear.	Do.	Do.
24	416	160	29.873	— 8.4	6.3	24.1	056	040	026	79	70	86	N E b E	N E b E	s E b E	63.40	4.0	...	6.40	Cu. Str. 4.	Snow.	Snow.
25	29.650	29.830	912	21.4	22.1	20.1	083	084	111	78	71	72	w s w	s w	w s w	90.60	5.5	...	2.15	Clear.	C. C. St. 8.	Cu. Str. 10.
29	30.090	30.050	30.167	19.0	29.8	20.4	087	142	074	84	88	85	s s w	s w	s b E	92.10	5.0	...	...	Cu. Str. 4.	Cu. Str, 10.	Do. 10.
27	29.999	29.920	29.810	16.0	30.6	24.6	074	130	091	83	78	80	s E b E	w b s	w b s	7.10	0.0	...	...	Do. 10.	Do. 10.	Do. 10.
28	760	840	671	22.1	26.2	19.1	090	105	105	78	73	84	s s E	w s w	w s w	103.10	5.0	...	1.00	Do. 4.	Snow.	Snow.
29	510	517	761	21.1	23.1	19.0	096	084	087	84	71	84	w s w	w s w	s w	379.40	2.5	...	1.10	Cu. Str. 10.	Cu. Str. 10.	Cu. Str. 10.
30	857	872	879	8.7	16.8	18.4	042	068	.082	86	75	82	w	w s w	w s w	346.40	2.0	...	...	C. C. Str. 8.	Do. 10.	Do. 10.
31	884	920	930	14.7	21.0	18.1	061	080	052	75	71	84	w s w	w s w	w s w	69.50	2.0	...	...	Cu. Str. 10.	Do. 10.	Do. 4.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR DECEMBER.

Barometer	Highest, the 18th day	30.640
	Lowest, the 1st day	29.173
	Monthly Mean	29.918
	Monthly Range	1.476
Thermometer	Highest, the 20th day	34°.0
	Lowest, the 14th day	—13°.0
	Monthly Mean	18°18
	Monthly Range	47° 0

Greatest Intensity of the Sun's Rays .... 51°.7
Lowest Point of Terrestrial Radiation .... —14°.1
Mean of Humidity .... .786
Rain fell on 1 day, amounting to 6.714 inches; it was raining 14 hours and 10 minutes.
Snow fell on 12 days, amounting to 21.56 inches; it was snowing 84 hours and 54 minutes.
Most prevalent wind, the W.
Least prevalent wind, the S.
Aurora Borealis visible on 1 night.
Lunar Halo visible on one night.
Zodiacal Light bright.
The Electrical state of the Atmosphere has indicated moderate intensity.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR JANUARY, 1861.

Barometer	Highest, the 23rd day	30.687
	Lowest, the 10th day	29.357
	Monthly Mean	29.963
	Monthly Range	1.350
Thermometer ...	Highest, the 2nd day	31°8
	Lowest, the 12th day	—34°7
	Monthly Mean	10°48
	Monthly Range	66°5

Greatest intensity of the Sun's rays .... 33°4
Lowest point of Terrestrial Radiation .... —36°6
Mean of Humidity .... .752
Rain fell on 1 day, amounting to 0.100 of an inch; it was raining 4 hours 10 minutes.
Snow fell on 11 days, amounting to 31.88 inches, it was snowing 69 hours and 30 minutes.
Most prevalent wind, the N. by E.
Least prevalent wind, the N.
Most windy day, the 19th day; mean miles per hour, 42.08.
Least windy day, the 27th day; mean miles per hour 0.30.
Zodiacal Light very bright and well defined.
Aurora Borealis visible on 2 nights.
The Electrical state of the Atmosphere has indicated constant and moderate intensity.

MEAN RESULTS OF METEOROLOGICAL OBSERVATIONS AT HAMILTON, C.W., FOR THE YEAR 1860.—BY DR. CRAIGIE.

MONTHS.	THERMOMETER.					BAROMETER.			DAYS.			YEARS.
	Mean at 9 A.M.	Mean at 9 P.M.	Mean of both.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Rainy.	Slight Showers.	Dry.	Mean Temperature of
	°	°	°	°	°							°
January	25.90	27.90	26.90	58	-5	29.603	30.08	29.12	4	7	20	1848...49.295
February ...	23.93	25.52	24.72	58	-2	.613	.06	28.94	5	7	17	1849...48.105
March	36.20	37.40	34.80	70	13	.534	29.90	29.10	2	4	25	1850...48.732
April	42.30	42.20	42.26	70	19	.590	30 22	.00	0	11	19	1851...48.756
May	58.50	57.50	58 04	82	33	.593	29.88	.22	2	10	19	1852...48.248
June	67.93	66.40	67 16	89	45	.574	.91	28.97	3	6	21	1853...49 474
July	69.38	68.67	69.03	88	48	.609	.87	29 30	2	5	24	1854...49.103
August	68.61	69.10	68.85	92	49	.645	.92	.33	1	12	18	1855...47.316
September..	58.80	58.93	58.86	87	30	.740	30.10	.30	2	7	21	1856...44.888
October.....	49.03	50.67	49.85	77	32	.686	29.95	.12	5	7	19	1857...45.868
November...	39.60	40.53	40.06	67	4	.508	87	28.88	3	9	18	1858...48.142
December ...	25.51	26.10	25.80	48	0	.660	30.17	.86	4	3	24	1859...46.996
Mean temperature of year...47.35						Mean height...29.613			33	88	245	

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SOME NOTES ON THE DRIFT DEPOSITS OF WESTERN CANADA, AND ON THE ANCIENT EXTENSION OF THE LAKE AREA OF THAT REGION.

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(Read before the Canadian Institute, March 16th, 1861.)

The following notes and deductions are the result of a careful examination of the Drift deposits of Western Canada, undertaken during the last three or four summers in an unsuccessful search for marine post-tertiary fossils, such as occur so abundantly in many parts of Eastern Canada and throughout the New England States. The district more especially investigated, extends from the Bay of Quinté westward to the mouth of the Saugeen on Lake Huron, and includes the line of country lying along, and immediately within, the outcrop of the Laurentian rocks north of that region. Detached observations have been made, moreover, at various points on the islands and north shore of Lake Huron; and also beyond the limits of the Province, as in the district south of Lake Ontario, in Michigan, and along the southern shore of Lake Superior.

The notes recorded here, are arranged under two sections, of which the first comprises a collection of data, and the second a corresponding series of deductions.

§ 1. *Data.*

1. The first point observable, with regard to our drift deposits, is the very evident fact that the rock floor on which these accumula-

tions are spread, had been extensively denuded prior to their deposition upon it. They cover, thus, an undulating and more or less broken surface; and their thickness, consequently, apart from the denudation to which they have been themselves subjected, is exceedingly variable.

2. The lowest of these deposits appear to consist of dark blue or greyish clays, with thin layers of yellowish or light-coloured clay in places. This deposit is often laminated horizontally, and is generally very calcareous. It appears also to be free from northern or large crystalline boulders. Pebbles of limestone and other fossiliferous rock, mixed with some small pebbles of water-worn gneiss, occur abundantly in it in many localities; but northern boulders, properly so-called, are either absent or exceedingly rare. Amongst the localities in which these lower and boulder-free clay deposits are of marked occurrence, the district around Toronto, and many parts of the valley of the Saugeen and western shores of Lake Huron, may be especially mentioned; but wherever our drift deposits are found to consist of clay and other materials, the clay-beds are almost invariably seen to occupy the lower place. At the same time, as described more fully in the sequel, beds of yellow and other coloured clay, it should be observed, are occasionally found with northern boulders in a higher part of the series,—but these are quite distinct from the lower clays now referred to. They are, moreover, of no great thickness, but alternate with, and are subordinate to, thick deposits of gravel and sand; whereas, the lower clays attain in places to a thickness of over 100 feet, and present a general uniformity throughout. In these latter beds, no traces of contemporaneous fossils have, as yet, been found.

3. It is generally assumed, as an established fact, that the harder rocks beneath the Drift exhibit everywhere the marks of glacial action. Although we have numerous examples throughout this section of the Province, of polished and striated rock, I believe it to be still an open question as to whether the rocks which underlie these lower clays, have been thus affected. I have not been able to discover any instances of it, nor can I find any recorded cases in our Geological Reports, or in other trustworthy sources. The question, hitherto, does not seem to have been mooted,—the Drift accumulations, generally, being classed together by most observers under one

ɔn term. As the point is of much interest, however, it should ıt in view.

ıbove the lower clay deposits, or resting immediately (where are absent) on the foundation rock of the country, we meet series of sands and gravels of evidently northern origin, cong boulders of gneissoid and other rock, and alternating occaly with beds of clay, in which northern boulders are also frely found. This clay, with scarcely an exception, is remarkably om calcareous matter,—the cause of which will be alluded to r on. In some places the clay and gravel are mixed up to, and present no signs of stratification; but more usually are distinctly stratified, and the boulders are mostly accumu towards the upper part of the series. As a general rule, in the boulders occur in by far the greatest abundance, scattered, , over the surface of the gravels; or resting immediately on the lying rocks where the clays and gravels are absent. This ap to have arisen, in some cases, from the subsequent removal, or ng away, of the looser materials in which the boulders were ally imbedded; but the greater number of these were evidently n down where they now lie, by melting or stranded icebergs, the deposition of the other Drift materials. The boulders, ıer of gneissoid or fossiliferous rock, belong always to northern ties, in relation to the spots on which they now occur. Here here, the infiltration of water containing bi-carbonate of lime, emented some of these upper Drift deposits into conglomerates nsiderable solidity. (Burlington Heights; vicinity of Niagara ; Georgetown, &c.)

Under the gravels and sands, or where the isolated boulders of eries are found, the rocks are always more or less marked by l action. The more common effects comprise: a smoothed and ıed surface, and a fine striation—the striæ running in long ht lines in a general N.E. and S.W. direction, although followo a certain extent, in hilly and broken districts, the natural ings of the rock slopes on which they occur. These effects are in Western Canada, at various heights above the sea-level, up elevation of at least 1500 feet. They are well shown on the f the Collingwood escarpment, at about 1000 feet above the of Lake Huron; on the same line of escarpment near Niagara ; on many of the rock exposures on the north shore of Lake

Huron, and throughout the country at the junction of the Laurentian and Silurian formations, between the river Severn and the County of Frontenac. Also in the vicinity of Belleville, Trenton,* &c.

The isolated boulders scattered over the country, frequently exhibit in themselves a polished and striated surface; and the small boulders and pebbles imbedded in the gravel deposits, often present the same effects. (*e.g.* The pebbles found in the terraces north of Toronto; also those in Drift gravel in the environs of Belleville, Marmora, Guelph, Niagara Falls,† &c.)

6. The gravel and sand beds of this series occur, in places, in oblique stratification, or exhibit what is technically termed "false bedding." This occurs at or near the upper part of the series, and is evidently due to a re-arrangement of the materials by the action of currents. (*e.g.* Drift-bank seen in Great Western Railway cutting at Toronto, and extending westward several miles; beds at Orillia, on Lake Couchiching; also near Collingwood, &c. A remarkable example, alluded to more fully in the second part of this paper, Deduction 3, occurs near the village of Lewiston, on the south shore of Lake Ontario.) I think it will be rendered clear, by what follows, that the currents in question were not marine, but were produced in the lake waters, when these stood at higher levels. In places, moreover, secondary ridges, or ancient spits, have been formed by the same action out of these drift materials. (*e.g.* Ridge at Weston, near Toronto, described by Sandford Fleming, C.E., in the present number of the *Journal*; and a ridge in Nottawasaga Township, described by the same engineer, *Can. Jour.*, 1st series, vol. i. Also the ridge at Craigleith, in Collingwood Township, mentioned by the writer, in this *Journal*, vol. v. p. 305.) These secondary ridges, it should be observed, are altogether distinct from the terraces of the lake shores and intervening districts. A careful search would, no doubt, reveal their presence in very many localities.

7. We now come to a fact of great interest: the occurrence of shells of fresh-water mollusca in the sands and gravels of these Drift deposits, at various levels above the present surface of our lakes. These shells belong to existing species, inhabitants of the surround-

* See a paper, by the writer, "On the Geology of Belleville and its Environs," in the *Canadian Journal*, Vol. V. (New Series), pp. 41–48.

† The localities cited in this paper, are those which have come more immediately under the author's observation. In most instances, the lists given might be greatly added to.

ing waters. They must not be confounded with similar shells left in elevated spots by the drying up of streams and ponds, or by the cutting back and lowering of river-beds. As occurring in our modified drift deposits, they are imbedded in sand or gravel containing northern pebbles and small boulders; and in situations, moreover, in which it is evident that no merely local causes could have been concerned in their deposition. The fragility of most fresh-water shells, necessarily operates against the preservation of these in the coarser sediments, and explains their absence, probably, as regards the upper Drift beds of many localities.

In some of these re-sorted beds, the bones and teeth of both extinct and existing mammals are occasionally found. The extinct forms comprise: a species of Mastodon (*M. Ohioticus?* see *Can. Jour.* New Series, vol. iii. p. 356); the *Elephas primigenius;* and apparently an extinct species of the horse. The remains of existing species found in these deposits (always confining our remarks to Western Canada), include the Wapiti, the Moose, Beaver, Musk-rat, &c. These two classes of remains have been found together. In a railway cutting through Burlington Heights, near Hamilton, the tusk of a Mammoth (*Elephas primigenius*) and the horns of a Wapiti (*Elaphus Canadensis*) were met with at a depth of about forty feet below the present surface of the ground.* I have also seen the lower jaw of a Beaver (*Castor fiber*), obtained from the same locality. The flint arrow-heads, and other wrought implements of Amiens and Abbeville, which are now attracting so much attention in Europe, occur, apparently, in deposits of the same kind and age.

I have discovered fresh-water shells, under the conditions described above, in beds of stratified Drift consisting of coarse gravel filled with pebbles of gneiss and other northern rocks, on the Kingston road, about two miles east of Belleville, at an elevation, by rough measurement, of about 40 feet above the present level of Lake Ontario. These belong to *Planorbis trivolvis*, or to some closely related species. Other examples of the same shell were obtained from fine gravel in oblique stratification, near the village of Orillia, at a height of about 18 feet above the level of Lake Couchiching. This lake is about 120 feet higher than Lake Huron, and about 700 feet above

* See a paper on the Geology of this district, by Charles Robb. C.E., in this Journal, New Series, Vol. V. p. 510.

the sea. Pieces of nacreous shell (belonging to a species of unio?) were also found in gravel, in the vicinity of Barrie, at an estimated height of about thirty feet above Lake Simcoe. I have found lacustrine and terrestrial shells in many other places, but these I omit from mention, as the shells occurred on the sites of ancient swamps, in gullies, or in flat lands adjacent to running streams; or in other doubtful situations in which they may have been deposited by freshets and other agencies of comparatively recent date.

Mr. Robert Bell, of the Geological Survey of Canada, has added greatly to the above localities, in a valuable paper published in the *Canadian Naturalist* for February of this year (1861). Amongst other spots in which he has discovered fresh-water shells, the environs of Collingwood and Owen Sound may be cited. At the former, examples of *Planorbis trivolvis*, associated with several species of *helix*, were found by him at an elevation of seventy-eight feet above Lake Huron. Specimens of *Melania conica* have been obtained, according to Mr. Bell, from another spot in this locality. Dr. Benjamin Workman, of Toronto, has also communicated the discovery of examples of a *Melania* and *Unio ellipsis*, on the high banks of the Don, about thirty feet above the lake. These may have been deposited by the river, however, when flowing at a higher level; but they were covered, according to Dr. Workman, by a considerable deposit of sand.

The upper deposits of the Drift period are separable with difficulty in many places from those of more recent age. As the one period merged gradually into the other, this must necessarily be the case. Among the more recent deposits of Western Canada, however, our river "flats" may be more especially cited, as those of the Grand River, filled with the remains of land mollusca. Also, the closely-similar deposits of the ancient bed of the Niagara, so high above the present level of that river; together with the shell-marls and calcareous tufas of our lakes and streams; and our deposits of bog iron ore and iron ochres.

§ 2. *Deductions.*

The following deductions appear to flow naturally from the observations recorded above:

1. A general depression of the land, at the commencement of the Drift period, must have taken place to such an extent as to admit of

the deposition of the lower clays. These latter were evidently derived from the limestones and other Silurian and Devonian strata lying beneath and around them. Hence their generally calcareous nature. Their derivation from this source is proved, moreover, by the pebbles of Trenton limestone and other fossiliferous rocks which they frequently contain. Extensive denudation must thus have occurred both immediately prior to, and during, the deposition of these clays; but it may be questioned whether the bolder contours offered by the denuded rocks, such as the escarpment that sweeps from the Niagara river to Cabot's Head on Lake Huron, were not produced during the first uprise of the palæozoic strata from the earlier seas in which their materials were accumulated, ages before the period now under discussion. It appears, at least, to be a well-admitted point, that these rocks had been elevated into dry land before the deposition of the higher formations in the south and west.

2. After the deposition of the lower Drift clays, a sudden and abrupt change in the character of the sediments took place. A striking example of this may be seen in the natural sections about Hogg's Hollow, a few miles north of Toronto. The change in question must have been effected by a still further depression of the country, bringing the higher lands and gneissoid strata of the north within the influence of the waves, and yielding the sands, gravels, and boulders of the upper Drift accumulations. This depression permitted an invasion and broad extension southwards of the ice-covered Arctic seas, the true cause, in all probability, of the cold of this epoch. The depression must have exceeded 1,500 feet, since northern boulders are found at that height above the sea, on the Collingwood escarpment. The gneissoid boulders there met with, must at least have traversed the basin of Georgian Bay; but the glacial striæ which also occur there, may have been produced by the action of ice, originating at the spot itself. The three or four distinct sets of striæ observed at this locality, however, do not radiate from any fixed point, but run in the usual north and south direction, some being a little east and others a little west of north.*

3. At the close of this second series of phenomena, a gradual uprise of the land appears to have taken place, and a vast area, extending

* On a visit to this spot, since the publication of the "Note on the Geology of the Blue Mountain Escarpment," in the *Canadian Journal*, Vol, V. p. 304, some additional sets of striæ were observed.

over and around our present lake basins, then became converted into a fresh-water sea. This probably found its outlet to the ocean through what is now the broad valley of the Mississippi. Its waters stood at a great elevation above the waters of our present lakes, and were gradually lowered to these levels by physical changes in the surrounding country, and more especially by the depression of a higher region lying to the east. During this gradual fall and retrocession of the great lake waters, the upper layers of the Drift were re-sorted, mixed with newer sediments, and thrown up here and there into secondary ridges; and the remarkable terraces which form so salient a feature in the general aspect of our lake shores and intervening districts, were then in chief part produced. The escarped faces of these Drift terraces, it should be observed, *always front the present lake-basins*, and thus look in some places towards the north, and in others towards the south, &c., according to the direction of the nearest shores. This would necessarily arise if they were produced, as here imagined, by a gradual lowering of the waters, with intervening periods of repose. The shells of fresh-water mollusca, buried in the modified Drift, at various levels above the existing lake-waters, and in localities so far apart—for these shells have been found throughout the region south of the lakes, in addition to the localities mentioned in this paper—prove incontestibly the former expansion and union of our lakes, or, in other words, the presence in this part of Western America, of a widely-extended fresh-water sea, covering an enormous area. A curious circumstance, and one of great significance in its bearings on this question, is the fact that all the inclined layers of modified Drift (to the east, at least, of Lake Superior) appear to slope towards the west or south. A remarkable instance of this, hitherto, it is believed, unnoticed, may be seen near the mouth of the Niagara river, at Lewiston. At this spot, oblique layers of modified Drift, in beds made up of coarse gravel and pebbles, point nearly due south, and thus bear witness to the fact, that the current, which occasioned the inclined stratification, must have set directly up the gorge, *or against the direction of the present stream*.

The assumption of an immense fresh-water lake of this character, gradually falling from a high level, necessarily involves the additional assumption of an eastern barrier, extending at one period between the lake-waters and the Atlantic. This view was maintained by some

of the earlier investigators of our geology, and, notably, by Mr. Roy, in his much-discussed paper on the terraces of Lake Ontario, communicated to the Geological Society of London, in 1837.* The difficulty of finding a satisfactory location for a barrier of this kind, led Sir Charles Lyell, however, to reject the idea of an original lake extension, and to refer the formation of our terraces entirely to the action of the sea, during the slow uprise of the land at the commencement of the present epoch. In this, he has been followed by all geologists who have subsequently examined these terraces. The difficulty may perhaps be surmounted, by assuming the earlier and greater elevation of that portion of the country lying to the east of the gneissoid belt which connects our northern Laurentian district with the Adirondack Mountains of New York. The subsequent depression of this region would open an eastern outlet to the lake-waters, and gradually lower these to their present levels. But whatever the explanation, the undoubted fact remains, that, at the close of the Drift period, a vast fresh-water sea extended over the greater portion of Western Canada, and at a level of at least 500 feet above the present surface of Lake Ontario.

Whilst the mollusca of this ancient lake were identical with existing species, its shores were peopled by the mastodon and the mammoth, and probably by other extinct forms of life, together with various species that still survive. A great question remains to be solved. Our gravel beds may perhaps reply to this, and reveal to us, that here, as in Europe, man and the departed mammoth once trod the earth together. Could this be established, the discovery would be fraught with even deeper interest than that which attaches itself to exhumed human relics of the ancient plains of Picardy and the gravel-beds of Suffolk. Our Indian arrow-heads are disentombed by hundreds: the connecting link of the extinct tooth or bone may not be long forthcoming.†

* See likewise the paper already referred to, by Sandford Fleming, C.E., on the physical characters of the Nottawasaga Valley.—*Can. Jour.* First Series, Vol. I. Mr. Roy's paper, I believe, was never printed.

† Since writing the above, Albert Koch's account of the discovery of the Missouri mastodon has come under the author's notice. In this account, published in 1841, it is stated that the mastodon bones were found in more or less immediate association with large arrow-heads. The same writer also attests to the discovery of wrought implements in connexion with Edentate remains in Gasconade county, Missouri.

NOTES ON LATIN INSCRIPTIONS FOUND IN BRITAIN.

PART VII.

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37. In Horsley's *Britannia Romana*, Durham, nn. xi. and xii., we have copies of two inscriptions on stones found at Lanchester :—

(XI.)

IMP · CÆS · M · ANT · GORDIA
NVS · P · F · AVG · BALNEVM · CVM
BASILICA A SOLO INSTRVXIT
PREGNLVCILIANVM · LEG AVG
PR · PR CVRANTE M · AVR
QVIRINO PRE COHILGOR

(XII.)

IMP · CÆSAR · M · ANTONIVS
GORDIANVS · P · F · AVG
PRINCIPIA ET ARMAMEN
TARIA CONLAPSA RESTITV
IT PER MAECILIVM FVSCVM · LEG
AVG · PR · PR · CVRANTE · M · AVR
QVIRINO PR · COH I · L · GOR.

Horsley reads and expands them thus :

(XI.)

"Imperator Caesar Marcus Antonius Gordianus pius felix Augustus balneum cum basilica a solo instruxit per Gneium Lucilianum legatum Augustalem propraetorem curante Marco Aurelio Quirino praefecto cohortis primæ legionis Gordianæ."

(XII.)

"Imperator Caesar Marcus Antonius Gordianus pius felix Augustus principia et armamentaria conlapsa restituit per Maecilium Fuscum legatum Augustalem propraetorem curante Marco Aurelio Quirino praefecto cohortis primæ legionis Gordianæ."

The points obviously open to objection, in these readings and expansions, are *Gneium Lucilianum,* in n. xi., and *Cohortis primæ legionis Gordianæ* in both. Instead of "*Gneium,*" we should read *Egnatium,* as proposed by Mr. Ward, and established by an inscription on an altar found at High Rochester (*Bremenium*), (Bruce, *Roman Wall,* p. 457), in which the name of *Lucilianus* is given as EGNAT. In the rendering *cohortis primæ legionis Gordianæ,* the absence of the number of the legion at once suggests doubt, and this is strengthened by the consideration that there is no evidence that any legion, known to have been in Britain, bore the title *Gordiana*

As to Mr. Gale's conjecture, that the "legion here called *Gordiana* was the *legio sexta victrix,*" there is no other ground for it than that "the stated quarters [of that legion] were at York. whilst the other legions had theirs at a much greater distance." Mr. Smith (*Collect. Antiq.* iv. p. 142) with equally little reason, refers the inscriptions to "the twentieth legion, apparently the *legio Gordiana.*"

An examination of the words preceding *legionis Gordianæ,* scil. *præfectus cohortis,* suggests fresh doubt, for there is no authority for a *præfect* of a legionary cohort, whilst the term is the usual designation of the commander of an auxiliary cohort. Moreover, the order of the words—*cohortis legionis,* and not *legionis cohortis*—is so unusual, if not unprecedented, as in itself to cause dissatisfaction. Influenced, probably, by these considerations, Henzen, n. 6626, rejects the expansion, *legionis Gordianæ,* although accepted by Orelli, n. 975, and suggests *Ligurum,* or *Ligurum Gordianæ;* but neither of these readings appears to me probable.

I interpret COH · I · L · GOR · as *cohortis primæ Lingonum* Gordianæ.* We know that there were three, probably four, cohorts of the Lingones in Britain. Trajan's† *tabulæ* inform us that the fourth‡ was

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* I do not recollect having seen a similar use of the first letter of the ethnic name of a cohort; but in this case no confusion could arise, for, so far as we have evidence, there was no other corps, that served in Britain, whose initial letter was L.

† Mr. Wright (*Celt, Roman, and Saxon,* pp. 362, 363), through some strange inadvertence remarks on these *tabulæ*—"They are all decrees of the Emperor Trajan;" and, again speaking of the inscription found at Malpas,—"The date of this record is fixed by its internal evidence to the 20th day of January, A.D. 103. The other similar monuments found in Britain are all of the same year."

‡ It appears that there is a difference in the number of the cohort between the outer and inner inscriptions of this diploma. The latter, it is stated, gives IIII and the former III. It is not easy to decide which is the correct number. Gazzera, Henzen, and Böcking prefer III.

serving in Britain in A.D. 104, and the first in A.D. 105–106; whilst Hadrian's diploma notices the second in A.D. 124. According to the *Notitia*, the second was stationed at *Congavata* (Burgh-upon-Sands?); and the fourth at *Segedunum* (Wallsend), near which an altar has been found (Bruce, *Roman Wall*, p. 85), erected by a Præfect of that corps.

Horsley (*Durham*, xv.) gives the following inscription (on a stone also found at Lanchester), which Dr. Bruce (*Roman Wall*, p. 461) regards as mentioning the first, not the second, cohort of the Lingones :—

GENIO PRAETORI
CL EPAPHRODITVS
CLAVDIANVS
TRIBVNVS CHO
I LING VLPM

i.e. Genio Prætorii* Claudius Epaphroditus Claudianus† Tribunus cohortis primæ Lingonum votum libens posuit merito.

Dr. Bruce (p. 460) figures a slab, found at High Rochester, which bears the inscription :—

IMP · CAES · T · AELIO
HAD · ANTONINO · AVG · PIO PP
SVB Q LOL VRBICO
LEG · AVG PRO PRAE
COII Ī LING
*E *Q F

Dr. Bruce gives *equitum* as the expansion of E Q; but the letters evidently stand for *equitata*—a contraction, of which there are many

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* Horsley strangely interprets—Genius the prætor; and the Index to the inscriptions in *Monum. Hist. Brit.* gives "Genius prætor?" There can be no doubt that *prætorii* is correct.

† Camden and Horsley regarded the cohort, which is named here, as the *second*, but I prefer Dr. Bruce's opinion. An objection to my reading—*Præfectus cohortis primæ Lingonum Gordianæ*—may be drawn by some from the designation of the commanding officer being here *tribunus*, not *præfectus*: but there is no doubt that both terms are applied to the commanding officer of the same auxiliary cohort. In the *Notitia*, the second and fourth of the Lingones are each under a *tribunus*, whilst it appears, from inscriptions on stones found in Britain, that they were each under a *præfectus*.

examples,* and which, in this particular case, is established by the following inscription in Fabretti, p. 486 :—

C · CAESIDIO
C · F · CRV · DEXTRO
EQ · COH · VIII · PRAET
COH · I · LINGONVM
EQVITAT · &c.

Camden gives an inscription, found at Moresby in Cumberland, which mentioned the second cohort—and it is believed that the same corps was noticed in two inscriptions (Horsley, nn. xiii. and xiv.) found at Ilkley in Yorkshire. One of these is so remarkable, that it deserves special notice, and I shall therefore consider it in a separate article. But to return to the Lanchester inscriptions—an obvious suggestion relative to L · GOR is, that it may be a misreading of LINGON ; but we may not disregard the leaf-stops in n. xii, after COH, I, L and GOR.

There remains but one other point requiring notice—the use of the word *principia*, of which I have never seen any other example except on the stone found near Bath (*Vide* article, n. 6 of these Notes), on which the letters between PR and PIA are illegible. Mr. Gale regarded the *principia* as "either the quarters of the legionary soldiers called the *principes*, or the place where the ensigns were kept ;" whilst Mr. Horsley "rather concludes it to be the General's pavilion." Dr. Bruce interprets the term as denoting "the chief military quarters," or "officers' barracks."

Mr. Smith (*Collect. Antiq.* iv. p. 142) observes :

> "The *principia* mentioned in the inscription, it need scarcely be observed, means the quarters of the chief officers, and place of deposit of the standards. The word occurs in an inscription of the time of Elagabalus [?] lately dug up near Bath, and published in the *Journal* of the Archæological Institute."

Mr. Smith doubtless inferred the meaning of the word *principia*, as found in the Lanchester and Bath inscriptions, from its signification, when applied to a place in a camp. But there is no authority, so far as I am aware, either in ancient authors or in inscriptions, whereby

* In Horsley's *Britannia Romana* (*Cumberland*, lxi.) we have the same mistake. He reads I̅ : HIS · EQ *prima Hispanorum equitum ;* it should be *primæ Hispanorum equitata*. In *Cumberland*, lii., and in *Northumberland*, lxxxviii., the reading is *Gallorum equitum*, instead of *Gallorum equitata*.

this or any other interpretation of the term, as applied to *a building*, can be confirmed.

P. S.—Since the foregoing was in type, I have observed in Henzen's Index, "Coh. I. Lingonum Gordiana," with the reference to Orelli's n. 975=Horsley's *Durham*, n. xii., but it does not appear whether this statement was made through inadvertence or with the intention of correcting the opinion expressed in n. 6626.

38. The following is the inscription, found at Ilkley, to which I referred in the last article:—

RVM CAES
AVG*
ANTONINI
ET VERI
IOVI DILECTI
CAECILIVS
LVCAN * S
PRAEF COH

Horsley expands it thus: "*Pro salute* Imperatorum Caesarum Augustorum Antonini et Veri Jovi dilecti Cæcilius Lucanus praefectus cohortis."

The point, which at once attracts attention, is the use of the unique phrase—*Jovi dilecti*, especially as applied to but one of the Emperors named on the stone. Horsley compares the Homeric* διοτρεφέες βασιλῆες, but the illustration throws but little light on this remarkable compliment so strangely limited to one of the Emperors. For my part, I am persuaded that the reading is erroneous. Independently of the objection arising from the unprecedented epithet, there is a singular omission—according to Horsley's expansion—of the deity to whom the altar was erected. This should, in my judgment, be supplied from the fifth line; and I venture to suggest that the true reading is IOVI · DOLIC · TI · *i.e.* IOVI DOLIC[HENO] TI[BERIVS], *Tiberius* being the prænomen of *Cæcilius Lucanus.* The epithet appears in various forms, such as *Dolicenus, Dolcenus, Dole,* and *D.*

39. In the *Gentleman's Magazine,* for November, 1860, an account is given of the proceedings of the *Yorkshire Philosophical Society,* at their

* Horsley might have cited διίφιλος, which more closely expresses the Latin *Jovi dilectus.*

monthly meeting in October. Mr. Kenrick, Curator of Antiquities, "called the attention of the members to the inscription on the monument of Flavia Augustina, discovered at the Mount, near York," and to the suggestion (which I offered in article 21) as to the letter I before LEG· being part of the abbreviation PRI., "This may have stood," the Report proceeds, "either for Princeps or Primipilaris, examples of both occurring in inscriptions. The latter is perhaps the more probable. * * * The monument in question, though coarse in execution, must have been costly, and we may conclude that Caeresius, who dedicated it to the memory of his wife and children, was a person of higher military rank than a common soldier." In articles 17 and 21 of my notes, I expressed a preference for *princeps* as the reading of PRI·; and on reconsideration of the subject, I see no reason for altering my opinion. It seems to me very improbable that the same contraction was used for the designations of two high officers of different rank; and the enquiry as to the meaning of PRI· appears to be no more than a search for a case in which the abbreviation certainly denotes either of them. If such be found, then it may, I think, be reasonably concluded that it was not used for the other. Now there is no example, so far as I am aware, which proves that PRI was ever used for *primipilus*; whilst PRI·PRI· in Orelli, n. 3451 (if that inscription be genuine) establishes the use of it for *princeps*. Moreover, in my notes on the subject, I had no reference to *princeps*, as "a common soldier," one of the *principes*, but to *princeps* as the designation of the chief centurion of the *principes*, and the second in rank of the centurions in a legion, for, as Vegetius, ii. 8, informs us, *Vetus autem consuetudo tenuit, ut ex primo principe legionis promoveretur centurio primi pili.* This use of *princeps*, as "the" *princeps*, not "a" *princeps*, is not uncommon. In Henzen, n. 6779, we have an example of an officer, who was—

PRIM·PIL
LEG·$\overline{\text{V}}$·ET LEG·$\overline{\text{X}}$·ET LEG·$\overline{\text{VI}}$·ITA·VT·IN
LEG·$\overline{\text{X}}$ PRIMVM PIL·DVCERET EODEM
TEMPORE·PRINCEPS·ESSET LEG·$\overline{\text{VI}}$

Vide also n. 6747.

In 6780 and 6781 we find the *princeps* of an auxiliary cohort in two inscriptions found in Britain:

(1.)

I O M
COH · II · TVNGR
M EQ · C · L · CVI
PRAEST · ALB
SEVERVS PR
AEF · TVNG · IN
ST VIC SEVRO
PRINCIPI

(2.)

* * * * * *
ET · NVM[INI · D ·]
N · COH · II · TVN
GROR · GOR · M · EQ
[C·] L · CVI · PRAE
EST * * * CLAV
D * * * * * PRA
EF · INSTANTE
AEL · MARTINO
PRINC · &c. &c.

Dr. Bruce (*Roman Wall*, p. 264) on the first of these inscriptions, and Mr. Hodgson (*Archæol. Æliana*, ii. p. 88) on the second, judiciously reject the interpretation of *princeps* as a proper name, or as the designation of the Emperor, and refer to Manutius as authority for "*primus princeps, secundus*," &c.

The opinion, which seems to have been held by both, would have been more clearly expressed, if they had distinctly stated that *princeps* alone (without *primus*) is used for the first centurion of the *principes*, just as *primipilus* is used for the first centurion of the *triarii*.

40. In the *Journal* of the Archæological Institute, n. 65, 1860, there is an interesting and carefully prepared paper by the Rev. Edward and Mr. Arthur Trollope, on "The Roman Inscriptions and Sepulchral Remains at Lincoln." As there are some points on which I differ in opinion from the learned authors, I purpose devoting two or three articles to the consideration of the doubtful readings or interpretations.

In p. 4 we have the inscription :

D · M
FL · HELIVS NATI
ONE GRECVS VI
XIT ANNOS XXXX
FL · INGENVA CO
NIVGI POSVIT

It is thus interpreted :—"To the divine shades,—Flavius Helius, a Greek by nation, lived forty years. The free-born Flavia erected this stone to her husband."

I cannot perceive any reason for rejecting the obvious interpretation of *Ingenua* as a *cognomen*. It is not rare: Mommsen (*Inscript. Neapol.*) furnishes several examples.

41. In p. 6 we have the inscription that formed the subject of article 20 of my notes :—

L · SEMPRONI · FLA
VINI · MILTIS · LEGVIIII
* ALAVDI SEVERI
AERVIIANORXXX
ISPANICA LERIA
CIVMA

The reading and interpretation of the third line, which seem to be most favourably received by the Messrs. Trollope, are the same as those which I suggested; but a preference is expressed for ISPANI · GALERIA, instead of ISPANICA · LERIA. It is remarkable that when I first saw the inscription, this reading suggested itself to me; but although recommended by the circumstance that the Galerian tribe was common amongst the Spaniards (Henzen, n. 5598), I rejected it on the ground, that there is no example, so far as I am aware, of such a position of the tribe, not only after the birth-place, but also after the years of age and of service. But the existence of *Leria*, as a town of *Hispania Tarraconensis*, seems to be questioned, apparently on the ground that it is "not found in Dr. Smith's Dictionary of Roman Geography." There can be no doubt, however, that it did exist: it is mentioned by Ptolemy, cited by Cellarius, i. p. 106.

The readings *civis* [or *civitate*] *maximi exempli* for CIVMA seem to me very improbable. I prefer my own suggestion—C · IVNIA

c[urante] Junia. In support of this it may be added that the ***Junia gens*** was common amongst the Spaniards, whence we may assume that IVNIA was an ordinary female name amongst them.—***Reinesius Syntag***, p. 137.

42. In p. 15, the stone is figured on which is the inscription given by Horsley, ***Brit. Rom., Lincolnshire***, n. 1 :—

DIS MNIBVS .
NOMINI SACRI
BRVSCI · FNI CIVIS
SENONI · H CARSS
NAE CONIVGIS
* * * * * * * *

" The memorial has been thus read :—

DIS MANIBVS
NOMINA (or NOMINII) SACRI
BRVSCI FILI CIVIS
SENONII ET CARISS
IMAE CONIVGIS
EIVS ET QVINTI F.

" The slab is broken off just below the last line [marked by asterisks], and the inscription may be imperfect."

Mr. Ward read the four middle lines: *Nominii Sacri Bruscifili civis Senonii et charissimæ Vaniæ conjugis.*

Horsley gives the expansion: " Dis Manibus Nominii Sacri Bruscifili civis Senonii et carissimæ Vaniæ conjugis ejus et Quintiæ."

Gough (*Camden's Britannia*, ii. p. 374) offers the astonishing note —that the first word in the fourth line " may as well be read LINCOLNI as SENONI."

I am inclined to suggest the reading: ***Diis Manibus Nominii Sacri Brusci filii, civis Senonii, et carissimæ conjugis, Lucii Quinti filiæ.*** This is favoured by the appearance of the remaining portions of the letters as given in the woodcut, but it may be LVCIE [scil. E for AE] QVINTI F[ILIAE], a reading which is recommended by having the name of the *conjux*.

43. In p. 17, the inscription on the grave-stone presented by Mr. Arthur Trollope to the British Museum, in 1853, is noticed :—

I · VALERIVS · I · F
CLA · PVDENS · SAV ·
MIL · LEG · II · A · P · F ·
> · DOSSENNI
PROCVLI · A · XXX
AERA * I D · SP
H · S · E

"The following reading of the inscription may be suggested—Julius (or Titus) Valerius, Julii (or Titi) filius, Claudia (*tribu*), Pudens, Savia, miles legionis II · Augustæ (or adjutricis) piæ, fidelis, centuriæ Dossenni Proculi, annorum xxx, ærum ii, de sua pecunia hoc sibi fecit (or hic situs est.)"

The appearance of the letters on the stone, as figured in the *Journal*, leads me to regard *Titus* as more probable than *Julius.* I also prefer *adjutricis* and *hic situs est.* For *de sua pecunia,* I would suggest *de suo peculio* (Orelli, n. 5553); and for *centuriæ*, *centuriâ*, as the usual construction seems to have been—the legion, cohort, or *ala* in the genitive, and the century or troop in the ablative. Thus in Renier nn. 3938, 3939, *centuria* and *turma* are given *in extenso.* On p. 17, the observation of Mr. Franks on this inscription is cited:

"It records Julius Valerius Pudens, son of Julius, of the Claudian tribe, and a native of Savia, a city in Spain; he appears to have been a soldier of the second legion, and of the century of Dossennus Proculus, and to have lived thirty years, two of them as a pensioner."

The tribe, being the Claudian, leads me to prefer (both here and in Gruter, 547, 10) *Savaria,* a town in Pannonia. *Vide* Reinesius, ch. viii. n. 5, and Orelli, n. 500. The interpretation, "two of them as a pensioner," is liable to the objections, that there is no number on the stone, which can be clearly read, and that there is no authority for "a pensioner." I am not sure that I correctly understand the use of the term by Mr. Franks, but if his meaning be, that Julius Valerius Pudens received pay for two years, as some of our discharged soldiers receive pensions, he has not at all expressed the sense of the Latin. The phrase AERA MERVIT means the same as STIPENDIA MERVIT, *i.e.* served [the stated number of] years.

But it is more important to notice the construction of the word in this inscription. Instead of AERVM we have AERA, for the last letter seems to be A. The number is so obliterated that it appears scarcely possible to propose a certain restoration; but per-

haps in this injured portion of the stone there was, besides the number, M standing for *meruit*.

I have pleasure in adding, that the Messrs. Trollope are the first, so far as I am aware, who have noticed the *ascia* in Britanno-Roman epigraphy.

44. In p. 19, we find the expansion,—Hic ex testamento positus (?)" for H · E · TEST · P. I prefer "Heres ex testamento posuit," the heir being the veteran named in the sixth line. This inscription is of much interest, as supplying another notice of the 14th legion. The only other stone found in Britain, which mentions this celebrated corps, is that dug up at Wroxeter, and now in the Library of the Grammar School at Shrewsbury, on which see *Notes*, p. iv. n. 14.

45. In p. 19, a stone is noticed which was found at Lincoln, during the early part of last year.

"The inscription, which is perfect, may be thus read:—

DIIS · MANIB
C · IVLI GAL
CALEN · F LVC
VET EX LEG · VI
VIC · PF NASEMF

"The person here commemorated may have been Caius Julius, of the Galerian tribe, son of Calenus, a native of Lucca (?), and a veteran of the sixth legion, styled *Victrix, pia, fidelis* (?). The concluding letters are inaccurately formed, and their import is obscure. *Nepos a suo bene merenti fecit*, has been proposed, but we confess our inability to offer any satisfactory explanation. The sixth legion, however, it must be observed, was styled *firma* and *ferrata*, which may suggest the more correct reading. It is doubtful whether it was ever styled *pia, fidelis*.

The inscription, although apparently plain, and moreover accurately represented in a woodcut prepared with great care from a photograph, presents more than ordinary difficulty. The objections to the readings, proposed by Messrs. Trollope, for the first three lines, are: that *C. Julius* has no *cognomen*—that the normal arrangement of the name of the father and the tribe is inverted—and that the sixth letter in the third line seems clearly to be I, not F.

I am inclined to suggest the following expansion:—*Diis Manibus Caii Julii, Galeria tribu, Caleni, (or Galeni), Lugduno, i.e.* of Caius Julius Calenus, (or Galenus), of the Galerian tribe, a native of Lugdunum. The only objection, worth noticing, which I see to this, is, that in the woodcut there is a mark resembling a point between N

and I; but it seems probable to me that the mark is the result of injury or of age. It is remarkable that there is a similar mark between L and I, in the fifth line of the inscription noticed in the preceding article.

LVG is a common abbreviation for *Lugdunum*, and in that city the Galerian appears to have been the ordinary tribe. *Vide* Horsley, *Brit. Rom., Monmouthshire*, n. 111, and Orelli, n. 4020

But the principal difficulty remains for consideration. To the reading of the last line,

·VIC·PF NASEMF

the Messrs. Trollope suggest the serious objections, that PIA FIDELIS can scarcely be accepted as an expansion of P·F, as it is doubtful whether the sixth legion was ever styled *pia, fidelis;* and that the concluding letters are so inaccurately formed, and their import so obscure, that they are unable to offer any satisfactory explanation. Let us first consider the question as to the application of the epithets *pia fidelis* to the sixth legion. Henzen certainly seems to have been of the opinion that this legion was not styled *pia fidelis*, for, in his index, whilst giving other titles, he omits mentioning these, and corrects two inscriptions in which those letters are found in connexion with the sixth. In his emendations I concur, for the use of CLAVD· in each of these cases shows that LEG·VII was intended; but the opinion that P·F, standing for *pia fidelis* were never applied to LEG·VI, may be refuted by several examples. In Britain, omitting some instances which may be questioned, we find examples in Northumberland, n. xliv.; Cumberland, nn. xxiv. and xlii.; and Westmoreland, n. vi., of Horsley's Collection. In Stuart's *Caledonia Romana*, p. 349, we find an inscription in which the words *piæ fidelis*, applied to the sixth, are almost *in extenso*. Again, in Bruce's *Roman Wall*, pp. 270 and 274, we have other examples of the application of P·F. Nor is the usage limited to Britain. Steiner, n. 611; Lersch, *C. Mus.* i, p. 14; and Dureau de Lamalle, *Annal. dell' Inst. Arch.* iv. 1832, p. 151, supply examples found on the continent.

In Bruce's *Roman Wall*, p. 250, we have *fidelis* in extenso; and in Mommsen's *Inscrip. Neap.*, n. 2852, "*fidel.*," but in both cases without "*pia.*"

As it has now, I conceive, been established, that P·F in the last line of the inscription under consideration should be read *pia fideli*, we may proceed to the last letters, read by the Messrs. Trollope as NASEMF. The ligulate form, read by them as NA, seems to me to

be VM. It is not uncommon, and is noticed by Horsley in his table of abbreviations. Assuming, then, that these letters are VM, and adopting the reading of the others by Messrs. Trollope, I would suggest *vivus monumentum sibi et maritæ fecit.* But I am not satisfied that E, after S, is the correct reading. The letter, as it appears in the woodcut, looks very like P. If this be the fact, then I would suggest :—*Vivus mandavit sua pecunia monumentum fieri.* According to my view, the inscription may most probably be read thus:

DIIS MANIB[VS]
C[AII] IVLI[I] GAL[ERIA]
CALENI LVG[DVNO]
VET[ERANVS] EX LEG[IONE] VI
VIC[TRICE] P[IA] F[IDELI] V[IVVS] M[ANDAVIT]
S[VA] P[ECVNIA] M[ONUMENTVM] F[IERI].

46. Amongst the valuable results of the exploration of the Station of *Bremenium*, which was made through the liberality of the Duke of Northumberland, in 1852, was the discovery of several inscribed stones. On one of these, as figured in Bruce's *Roman Wall*, p. 458, is the following imperfect inscription:

IMP CAE * * * * * * * * * * *
* * * * * * P·F * * * * * * *
* * * * CH·I·F·VARD * * * *
* * * * * BALLIS A SOLO RES
SVB C·CLAP * LINI LEG AVG
INSTANTE AVR QVINTO TR

Dr. Bruce remarks:

"The inscription may be read:

IMP[ERATORI] CAE[SARI]
P[IO] F[ELICI]
C[O]H[ORS] I F[IDA] VARD[VLORVM]
BALLIS A SOLO REST[ITVIT]
SVB C[AIO] CL[AVDIO] APELLINI[O] LEG[ATO] AVG[VSTALI]
INSTANTE AVR[ELIO] QVINTO TRIB[VNO].

In honour of the Emperor Cæsar,
Pious, happy.
The first cohort of the Varduli, *styled* the faithful,
———— from the ground restored,
Under Caius Claudius Apellinius, imperial legate;
Aurelius Quintus, the Tribune, superintending the work.

† Another reading may be suggested: *Vidua marito sua pecunia monumentum fecit.* My objection to it is that I have never seen *vidua* in any ancient inscription not Christian.

"The word *ballis* being peculiar, it would be rash to hazard a hasty explanation of it. It does not occur in Gruter. Is it the termination of some word? Is it a contraction for *balneis?* or has *b* been substituted for *v*, and should it be *vallis?* These are the most plausible suggestions which have occurred to me, but I am not satisfied with any of them. I have written the cognomen of the legate, as I think the inscription requires; it is necessary, however, to state that this name does not occur in Gruter."

In the year 1855, excavations were carried on at the same place, and a slab was discovered bearing the following inscription, as given by Dr. Bruce, in the interesting account published in the *Archæologia Æliana* (*new series*), vol. i. p. 78:

IMP · CAES · M · AV * * *
* * * * * PIO F * * * *
TRIB · POT X COS * * *
P · P · BALLIST · A SO * *
VARDVL * * * * * * * *
TIB · CL · PAVL * * * *
PR · PR · FEC * * * * *
P · AEL * * * * * * * * * *

This inscription, as Dr. Bruce observes, solves the question as to BALLIS in that found in 1852, for BALLIST suggests BALLISTARIVM, and we are also enabled to correct the reading of the name of the imperial legate, by substituting *Paulinus* for *Apellinius*. So far every thing seems satisfactory; but Dr. Bruce adds in a note:

"A comparison of the two inscriptions does not remove all the difficulties attending the reading of the name of the Proprætor on the slab found in 1852; but if the name of this dignitary be not (Tiberius) Claudius Paulinus, it is difficult to say what it is."

I am unable to understand the grounds of this remark. The name of the legate on the second slab seems to be, beyond doubt, *Tiberius Claudius Paulinus*, and from this we have to correct the reading on the first slab--*Caius Claudius Apellinius*. The substitution of *Paulinus* for *Apellinius* seems certain. *Claudius* remains in both, the only difference being that in the first we have the abbreviation CLA, in the second only CL—and all that remains to be done is to get rid of *Caius*, the prænomen in the first. Can there be any doubt that the C preceding CLA in that inscription stands not for *Caio* but for *cura*, *i.e.* that we should read *sub c[ura]?* *Paulini*, in the genitive, confirms the expansion.

Thus no difficulty regarding the names of this Propraetor remains. In one his *prænomen* is given; in the other it is omitted, as is frequently the case. In the Vieux inscription (Mr. C. R. Smith's *Collectanea Antiqua*, vol. iii. p. 95) the names of this same Propraetor also appear without the *prænomen*.—Compare the inscriptions 16*a*, 98, and 102*a* in *Monum. Hist. Brit.*

But another inquiry remains as to the age of the slabs. Dr. Bruce remarks on this point:

"The emperor here referred to is no doubt Heliogabalus. He assumed the same titles as Caracalla; but the character of the letters and the evidently intentional erasure of the distinctive part of his name, indicate the later rather than the earlier monarch. Fortunately the erasure in the second line has not been so effectually performed as to prevent the word ANTONINO being discernible."

Neither of the reasons given by Dr. Bruce seems to me conclusive evidence as to the emperor here referred to being Heliogabalus. Moreover, the examination of the date of the Vieux monument, by Mr. Roach Smith (*Collect. Antiq.*, iii. p. 98) does not favour this opinion. He observes:

"This monument was erected in the first year of the reign of the third Gordian. [In the inscription on the principal face the date is given—AN . PIO ET PROCVL·COS—which corresponds to A.D. 238.] The events mentioned in the inscriptions probably occurred a considerable time anterior to the setting up of the monument. M. Huet and the Abbé le Neuf believe that the Ædinius Julianus, præfect of the prætorium, whom Solennis went to Rome to see, and from whom he received this letter of recommendation [inscribed on the monument], is the Julianus mentioned by Herodian and Capitolinus, who held this high post in the time of Macrinus [*i.e.* before the commencement of the reign of Heliogabalus]. This was twenty years prior to the reign of Gordian, and as Julianus speaks of Paulinus as his predecessor in Gaul, Paulinus, in this case, must have been in Britain in the reign of Caracalla, possibly of Severus, when the sixth legion was in active service in the north of the island, repelling the Mæatæ and the Caledonians."

In the opinion of M. Huet and the Abbé le Neuf I concur. It seems very improbable that the *Julianus*, who was præfect of the prætorium under Commodus, was the individual named on the monument. I regard the *Ædinius Julianus* of the monument as most probably the same who is mentioned as *M. Ædinius Julianus* amongst the *patroni* of Canusium, in the well-known inscription (of the date A.D. 223) given by Mommsen, *Inscript. Neapol.*, n. 635.

47. In the *Journal of the Archæological Institute*, n. 67, 1860, p. 270, a tile from Caerwent is figured, which bears the name BELLICIANVS, four times written, in "what may be called the cursive hand [?] of the British Romans. The name Belicianus (with a single *l*) occurs on one of the tomb-stones from Bulmore, near Caerleon, and may possibly refer to the same individual."

To these observations of Mr. J. E. Lee, the following remarks are subjoined:

"The sepulchral stone found at Bulmore, to which Mr. Lee refers, is figured in his *Delineations of Roman Antiquities found at Caerleon*, pl. xxiv. p. 87. It bears an inscription in memory of Julia Veneria: it was erected by Alesander (*sic*) her husband and Julius Belicianus her son. The upper part of the stone forms a pediment, on which a dolphin is sculptured. The names Bellicius, Bellicinus, Beolicus, and also Bellianus, Bellienus, &c., occur in inscriptions given by Gruter. Bellienus was the name of a family of the *Annia gens*; Bellicianus may have been a name derived from that of the town in Gaul, of some note in Cæsar's campaign against the Allobroges, Bellicium, or Belica, now known as Belley. It is situated about forty miles E. of Lyons."

I am unable to consult Mr. Lee's work, as above referred to; but the inscription, which is cited, is the same as that given in Mr. Wright's *Celt, Roman, and Saxon*, p. 315:

"D. M.	To the gods of the shades.
IVLIA · VENERI	Julia Veneria,
A · AN · XXXII	aged thirty-three years,
I · ALESAN · CON	Alexander, her husband
PIENTISSIMA	most attached,
ET · I · BELICIANVS	and Julius Belicianus
F · MONIME	her son, this monument
F · C	caused to be made."

With this reading and translation I am by no means satisfied. The I at the beginning of the third line seems to me to be not a numeral, to be joined to XXXII in the preceding line, but the ordinary *nota* for *Julius*, scil. "*Julius Alexander.*" "Her husband most attached" is evidently a casual slip, as a translation of CON[IVGI] PIENTISSIMA[E], which, of course, means "to his most attached wife." The name BELICIANVS may perhaps be nothing more than the ordinary cognomen FELICIANVS, the B being used for F. MONIME is so strange an abbreviation of MONIMENTUM, that it excites suspicion as to the correctness of the reading. I venture to suggest—M · OPTIME,—*i.e.* M[ATRI] OPTIM[A]E. According

to this view, the inscription denotes that "Julius Alexander to his most affectionate wife, and Julius Felicianus to his excellent mother, caused [this memorial] to be made."

48. In 1848, Lord Palmerston presented to the British Museum a pig of lead, found at Carthagena in Spain, which bears the following inscription :*

M · P · ROSCIEIS · M · F · MAIC.

This inscription is identical with that on the block in the Collection of Antiquities at the Bibliothèque Imperiale at Paris, which was also found in Spain. Mr. Way (in an excellent article on "The Relics of Roman Metallurgy," in the *Journal of the Archæological Institute*, n. 61) notices a reading *in extenso* suggested by Mr. Newton, scil. *Marcus Publius Roscius, Marci filius, Mæcia* [*tribu*]. This does not appear to me satisfactory. On comparing it with Henzen's n. 5733, beginning M · P · VERTVLEIEIS · C · F ·, I am inclined to regard ROSCIEIS as an archaic form of the nominative plural, M · P · as standing for *Marcus* and *Publius*, and M · F for *Marci filii.* MAEC · may be an abbreviation of MAECII, for we know that *Mæcius* was amongst the names borne by members of the Roscian *gens* e. gr. Orelli, n. 4952:

L · ROSCIO · M · F · QVI
AELIANO · MAECIO
CELERI.

But I prefer Mr. Newton's MAEC[IA] *tribu*. Thus we have in Fabretti, p. 240.

L · RVSTICELLIVS · C · SCA [i. e. *Scaptia tribu*]
M · CVSINIVS · M · F · VEL [i.e. *Velina tribu*]

The omission of the cognomen is an evidence of rare antiquity in Latin Epigraphy and the same is indicated by the termination *eis*.

Henzen, (in a paper on the inscription n. 5733, published in *Bulletin dell' Institut. di Correspond. Arch. Rome*, 1845, and translated by Mr. Key, in *Proceedings of Philological Society*, vol. vi. p. 179) states that he has not met with this form of the nomina-

* The interesting character of this inscription will, I trust, be deemed a sufficient apology for my introducing some remarks on it, although not found in Britain. In a future Part I purpose taking up the inscriptions on the pigs of lead, of the Roman period, which have been found in Britain.

tive plural of the 2nd declension at a later date than about the middle of the seventh century of the City, *i.e.* about 100 years B.C.

It may be worth while to observe, that the omission of *et* between two names is not uncommon. We have an example in Henzen, n. 5733, —M · P · VERTVLEIEIS,—*i.e.* as we express it, *Marcus* and *Publius Vertuleius*. In Orelli, n. 3121, there is a similar form—Q · M · MINVCIEIS Q · F · RVF · i.e. *Quintus* et *Marcus Minucii, Quinti filii, Rufi*, or as we express it, *Quintus* and *Marcus Minucius Rufus, sons of Quintus*.

The inscription on the block I regard as showing that it was from the mines rented by the two Roscii. It is possible that they may have been public officers, but we should then probably have had their official designation.

NOTES ON THE DAVENPORT GRAVEL DRIFT.

BY SANDFORD FLEMING, C.E.

Read before the Canadian Institute, March 2nd, 1861.

The flat plain skirting Lake Ontario in the locality of Toronto, and on which the city is built, extends for many miles westerly, and is bounded on the east by the Scarborough Heights, and on the north by the terrace-shaped elevation known as the Davenport Ridge. This terrace crosses Yonge-street about half a mile north of Yorkville, immediately at the residence of the Hon. Mr. Morrison, and trends westerly and slightly north-westerly a little over three miles to the point where the Northern Railway crosses the Davenport road. At this point the terrace changes its direction, and a peculiar gravel deposit begins: the terrace, instead of continuing its uniform westerly direction, takes a sudden bend towards the north, and sweeps diagonally through the third and fourth concessions of the township of York, for a distance of nearly four miles, until it reaches the neighbourhood of Weston. Here it loses itself in the rising ground ascending easterly from the Humber, but is again developed on the western bank of that river, and, extending

southerly, becomes strongly marked near the village of Lambton, where it again makes a sudden detour and sweeps westerly along the line of Dundas-street and continues in a direction generally parallel to Lake Ontario through the neighbouring townships.

The gravel deposit already referred to, can likewise be traced over a considerable area, but, unlike the terrace in its windings into the interior, the gravel is found only in a uniformly straight direction, and that generally parallel to Lake Ontario. The gravel is found over a distance of two and a half miles in a well-defined, yet low, narrow ridge, averaging only about an eighth of a mile in width, in height from about fifteen to twenty feet in the centre, gently rounded, and sloping to the level ground on each side.

The terrace rises abruptly from the plain below to an elevation averaging from thirty to about fifty feet, and although generally known by the name of "The Davenport Ridge," it cannot properly be termed a ridge, as its summit either maintains its level as a table-land, or gently rises towards the interior in easy undulations.

Good sections of the gravel deposit are given in the ballast pits of the Northern and Grand Trunk Railways at points about half a mile apart, where these lines cross it at the Davenport and Carleton stations respectively. Both sections are so precisely similar in character that an illustration of one will suffice—(*See Plate*)—and it is not unreasonable to draw the inference that the same leading characteristics, similarly displayed at these points half a mile apart, obtain throughout the length of the deposit.

The terrace already referred to has frequently been noticed by geologists, especially where it crosses Yonge street, this point being easiest of access from Toronto. Sir Charles Lyell, in his "Travels in America," makes particular reference to it. He maintains that it marks the margin of the sea at some early period; others, again, consider it the former boundary of Lake Ontario. Following up the latter supposition we can scarcely avoid coming to the conclusion that the Davenport gravel ridge, from its peculiar outline and from its level, must have been washed by the ancient Lake Ontario in a manner precisely similar to that in which the singular and similar formation in front of Toronto harbour is washed by the present lake. We may even venture a step farther, and advance satisfactory reasons for attributing the origin and development of the Davenport gravel ridge to the action of the lake at its higher level. Many

gentlemen have submitted their views on the origin and progress of the formation which encloses Toronto harbour, as well as the adjoining sheet of water, Ashbridge's Bay. They nearly all agree that it is a deposit due to the continued action of the waves on the Scarborough Heights. Professor Hind very fully discussed the matter in an elaborate paper published in the *Canadian Journal* (first series); and the writer laid two papers on the subject before the Institute at an earlier period. It will not be necessary to go over the arguments given in the articles referred to. They seemed perfectly conclusive when applied to the ridge or shoal, island or peninsula, or whatever it may be called, in front of Toronto harbour. They are equally applicable to the Davenport gravel ridge, with Lake Ontario high enough to wash it, and if we are satisfied that the development of one formation is caused by the waves of the present lake, acting through a long course of years, in undermining the heights of Scarborough and in giving to the *débris* a progressive westward motion, we can have no difficulty in coming to a similar conclusion with regard to the formation of the Davenport gravel ridge, viz.: that it was gradually produced by the mechanical action of the waves of Lake Ontario when it stood at about 170 feet above its present level; that the materials of which the deposit is mainly composed are the insoluble portion of the *débris* formed by the destructive action of the waves on the terrace which stretches parallel to Lake Ontario and crosses Yonge street about half a mile north of Yorkville; that these materials have been transported westerly to their present resting-place by the singular progressive motion given to all beaches, under certain conditions, by the waves.

Admitting this to be the true history of the Davenport gravel deposit, and there can be little doubt of it unless it be assumed that the forces of nature have been entirely changed in their character as well as their mode of action, we are yet somewhat puzzled to account for some peculiarities in the stratification which are seen on a close inspection of the sections formed by the railway cuttings.

The gravel is not deposited in horizontal beds, as is generally the case with sub-aqueous formations, nor is it laid, as one would naturally expect to find it on accepting the foregoing theory as satisfactory, that is to say, in thin beds dipping southerly, or from the shore towards the water, as if they had been thrown up one over another on the inclined plane of the beach by the storms of the former lake.

On the contrary, we find the gravel invariably deposited in the opposite direction, that is to say, in beds dipping *away from* the lake, and, in some instances, nearly at right angles to what may have been the plane of the beach.

There seems only one way of accounting for this peculiarity, consistent with phenomena observed at the present day, and yet in harmony with the theory of formation already advanced.

We find on many similar drift deposits going on at the present time around Lake Ontario, as well as around all the great lakes, that the winds and waves under certain conditions produce results which will readily account for the peculiar stratifications at Davenport. It is, however, unnecessary to go farther than the formation already referred to in front of Toronto for an illustration. The long narrow spit which forms the eastern half of this formation, and which connects it with the main land, is perhaps under precisely the same conditions that the Davenport ridge was in with Lake Ontario at its supposed higher level. This modern spit is so low that it is not at all times above water; at the present moment a considerable extent of it is under water, at other times it is all or nearly all barely above the lake level; but, whether above or below water, it is exposed, when the wind blows *point blank* on the shore, to a destructive as well as an accumulative action, destructive on the outer or lake side and accumulative on the inner side.

These combined actions were observed by many a few years ago, when the special attention of the citizens of Toronto was drawn to the breach formed near Privât's hotel. Their effect on the deposit was chiefly to move it nearer the main shore, the materials being lifted by the waves from the outer slope and deposited on the inner side.

This action of the waves is not confined to a particular point. It may be witnessed to a greater or lesser degree along the whole extent of the spit, whether it be above or below the surface of the water, when the waves break on the beach at an angle not too acute. This difference, however, may be remarked: Where the summit of the ridge is above water, waves of greater force are required to wash the materials composing the beach over to the inner side.

The consequence of this action, continued year by year, must necessarily be a gradual recession of the formation and a stratification of its beds dipping towards the main land. The first agrees

with the ascertained facts, as careful surveys clearly show that the deposit is gradually approaching the main shore; and the second, although it has not to my knowledge been confirmed by actual excavations, cannot be called in question.

In this manner, it is thought, the peculiar dip of the strata at the Davenport gravel pits may be accounted for; but to perfect the analogy we must assume that the whole deposit was at one time considerably farther to the south.

Nor does this appear to be assuming too much when we reflect that the Davenport terrace, before being exposed to the long-continued destructive action of the waves, must have extended considerably farther southward, and hence the gravel spit, also, would be in a corresponding position. As the terrace gradually receded, or in other words, as the waves undermined the clay banks and the lake thus encroached upon the land, supplying fresh material for the extension of the spit, so also would the spit recede simultaneously with its extension westward, and, in this manner, produce the peculiarly inclined stratification, which at first sight appears not a little puzzling. Whether this theory be correct or not, it has at least the recommendation of being consistent with observed phenomena.

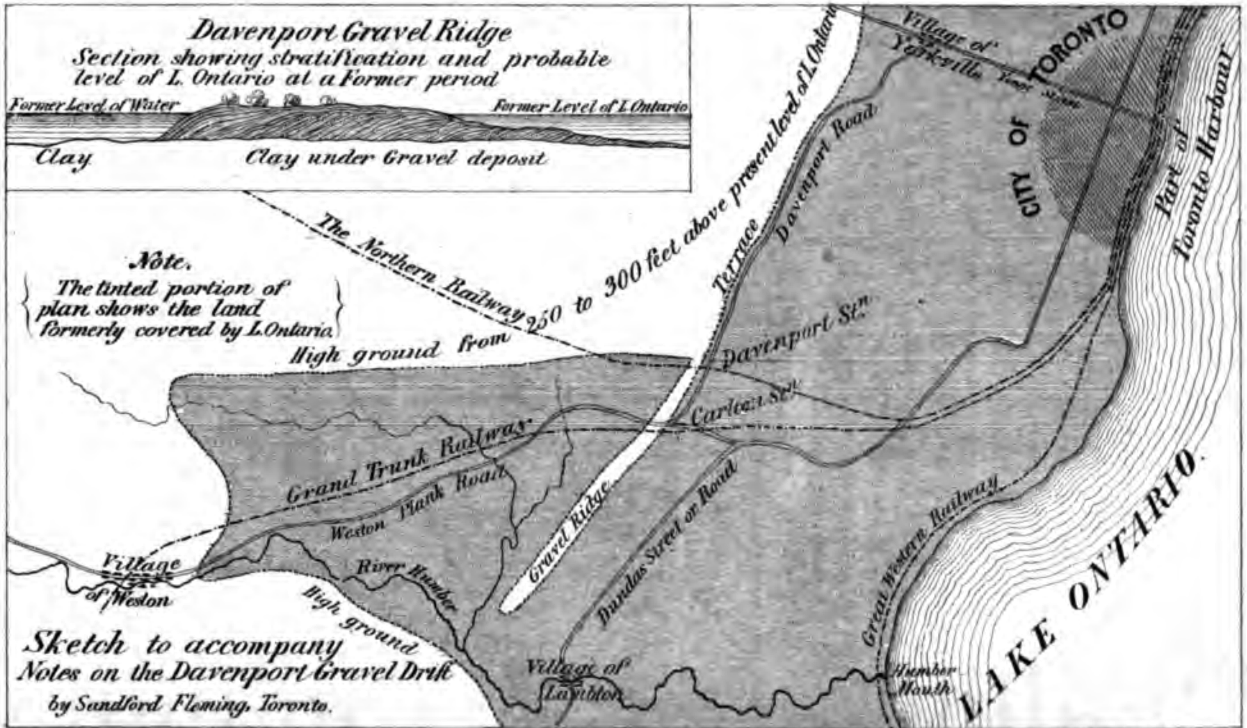
With regard to the character of the gravel found in the Davenport and Carleton pits, it varies in size from coarse sand up to pebbles one and two inches in diameter; the largest proportion of the deposit, however, consists of gravel under half an inch in diameter. There is nothing in the character of the materials composing the deposit inconsistent with the supposition that they at one time occupied a position in the drift clays of which the terrace is formed, or that they have travelled along its base (the former beach of Lake Ontario) impelled by the mechanical action of wind and waves. Indeed there is every argument to show that such has actually been the case. The particles of gravel are similar in character to rocky fragments found imbedded in the terrace, and they are rounded, which implies that they have been subjected to a rolling action in the water. The deposit is entirely free from clay (except in nodules hereafter referred to) which shows that the materials have not been deposited like ordinary sediment on the bottom of a lake. The entire absence of all large stones, or boulders, would likewise indicate that the materials have been brought by forces insufficient for the removal of these

substances; and the occurrence of boulders in very considerable quantities strewn along the flat land under the base of the terrace is a sufficient proof that they have been left behind.

The occurrence of nodules of clay, from an inch to two or three inches diameter, in some of the beds of gravel, is not a little remarkable, seeing that they are so soft as to be easily crumbled up in the hand. These clay nodules are not found in every bed, but only in beds here and there. Their presence may be accounted for by supposing that the waves had undermined a portion of the half frozen clay cliff in winter, and that some of the fragments had been rolled along the beach by the waves and ultimately washed up in their frozen condition and deposited where we find them. These fragments of clay are identical in character with the clay found in digging into the face of the terrace. Their rounded and water-rolled appearance would certainly go far to strengthen the above supposition, but in order to support it we are obliged to bring in the agency of frost. This may not only be quite justifiable, but the presence of these pieces of clay of the peculiar shape and in the singular position which we find them, may be some slender proof that the climate in those days long gone by was not unlike the climate at the present time.

The plate shows a section of the gravel deposit, as well as a sketch of its position in relation to the adjoining country. The tinted part is intended to represent the land which would be under water, with Lake Ontario 170 feet above its present level

We have had occasion in these observations to draw a comparison between the gravel deposit at Davenport and the formation now going on in front of Toronto; but perhaps the most remarkable resemblance in the character of both is that they denote the boundaries of two capacious natural harbours. The present one, the harbour of Toronto, is well known; and the ancient one must have occupied the whole of that flat expanse lying between the Davenport gravel ridge and the village of Weston, and must have embraced over seven square miles of sheltered water, or nearly double the area of Toronto Harbour. It is not a little strange that the same natural forces should be at work to-day in forming almost a duplicate of what they completed in the same neighbourhood before the commencement of history on this continent; for if the natural harbour of Toronto is not exactly similar in outline or in expanse to


Davenport Gravel Ridge
Section showing stratification and probable level of L. Ontario at a Former period
Former Level of Water
Former Level of L. Ontario
Clay
Clay under Gravel deposit
Note.
The tinted portion of plan shows the land formerly covered by L. Ontario
High ground from 250 to 300 feet above present level of L. Ontario
The Northern Railway
Terrace
Davenport Road
Davenport Str.
Village of Yorkville
CITY OF TORONTO
Part of Toronto Harbour
Carlton Str.
Grand Trunk Railway
Weston Plank Road
Gravel Ridge
Dundas Street or Road
Great Western Railway
LAKE ONTARIO.
Village of Weston
River Humber
High ground
Village of Lambton
Humber Mouth
Sketch to accompany Notes on the Davenport Gravel Drift by Sandford Fleming, Toronto.

the one above attempted to be described, it most certainly appears to be identical in character.

These observations lead us to the reflection that the agencies of nature have been as they are now, ever active in changing and remodelling the earth's surface. We find entombed in these gravel heaps at least a trace of the history of bitter winters, perhaps long anterior to the first appearance of even the Red Men in the valley of the St. Lawrence: a rude indication of the direction of winds, and of the force of storms which spent their fury at a period equally early, and a long history (written by their own agency) of waves which rolled many fathoms over the spot where we are now assembled, recorded in characters which cannot easily be effaced, and which when carefully read cannot well be mistaken.

ON THE DEVONIAN FOSSILS OF CANADA WEST.

BY E. BILLINGS, F.G.S.

(*Continued from* Vol. VI. *page* 282.—No. XXVIII. *May*, 1860.)

Genus *Spirifera*.—Sowerby.

SPIRIFER.—*Of the generality of Authors.*

Generic characters.—Hinge-line straight and either greatly elongated, or equal to, or less than the width of the shell; the general form, triangular, quadrate, oval, or sub-circular. The ventral valve the largest, with a flat or concave area varying greatly in its dimensions; a triangular foramen beneath the beak, usually open but sometimes partially closed by an arched plate called a deltidium or pseudo-deltidium. Area of dorsal valve smaller than that of the ventral valve. Surface either ornamented with radiating ribs, or finely striated, or smooth. In the interior the spiral cones have their apices turned outwards as in *Spirigera*, but they are destitute of the complicated appendages of this last-named genus. The muscular impressions are somewhat similar in their general form and relative position to those of *Athyris*, but subject to great variation according to the species. Shell structure not punctated.

This genus ranges from the Lower Silurian up to the Trias. In Canada we have found no species below the Clinton group.

A great many species of this genus have been described as occurring in the Devonian rocks of the United States; and in Canada West there are apparently fifteen or twenty, but owing to the imperfection of the specimens, several of these must remain for a while undetermined.

SPIRIFERA MUCRONATA.—(Conrad.)

DELTHYRIS MUCRONATUS.—(Conrad.) *Annual Report of the Geological Survey of New York*, 1841, *p.* 54. Hall, Geology of New York, part 4, 1843, p. 198.

Fig. 59.

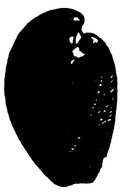


Fig. 60.

Fig. 61.

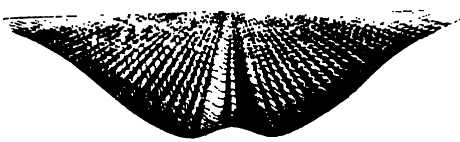


Fig. 62.

Fig. 59 *Spirifera mucronata*.—Ventral view. Fig. 60. Side view. Fig. 61. Dorsal view. Fig. 62. A long-winged variety of the same species.

Description.—This species varies from the semi-circular to the sub-triangular form. In general the hinge line is twice, and sometimes thrice the length of the shell; the cardinal angles acute, the side either straight or gently rounded and converging to the front margin, which is either straight or concave, and of the width of the mesial fold. The valves are moderately convex; the ventral more tumid than the dorsal; the mesial fold and sinus are rounded, and extend quite to the beaks; from fifteen to twenty not very prominent ribs on each side. The area of the ventral valve is very narrow, in the largest specimens scarcely more than half a line in height; the beak small, pointed and incurved over the area, but not in contact with the

umbo of the dorsal valve, a space of one-fourth to one-half of a line intervening. Area of dorsal valve sub-linear or about one-third the height of that of the ventral valve. The whole surface, in well preserved specimens, is covered with zigzag concentric imbricating striæ, from two to four in the width of one line.

Width on the hinge-line from one to two inches, usually one inch and a half. Length from beak to front from eight to twelve lines.

Locality and Formation.—Hamilton Group. Townships of Plympton and Bosanquet. Also found loose, or in boulders in the drift in numerous localities in the extreme western Counties of the Provinces.

Collectors.—A. Murray. J. Richardson. Also from W. B. Wells, Esq., Judge C.C. Chatham, C. W.

SPIRIFERA VARICOSA.—(Hall.)

SPIRIFER VARICOSUS.—(Hall.) *Tenth Annual Report of the Regents of the University of the State of New York*, 1857, *p.* 125.

SPIRIFER SUBMUCRONATUS OR SUBATTENUATUS + S. INUTILIS.—(Hall.) *Geology of Iowa.*

The species above quoted are all closely allied to each other, and also to *S. mucronata*. They differ from the latter in being in general a little smaller, and in having the umbo and beak of the ventral valve more prominent—the area of the same valve being consequently larger.

In the corniferous limestone numerous fragments and single valves have been collected, which most probably belong to *S. varicosa*, or to one or both of the others. I have referred them all to the former for the present provisionally, not being able to decide whether they are or are not identical therewith. At all events they must be most closely allied species.

Some of them have the mesial sinus regularly concave, while in others it is divided by an obscure ridge along the middle. The mesial fold on the dorsal valve is sometimes marked by a central groove, but often it is entire. The individuals thus marked should probably be referred to *S. bimesialis*. (Hall.) *Geol. Iowa.*

The following figures represent a specimen from the Corniferous, near Woodstock, with the length greatly less than the width and no median rib in the sinus.

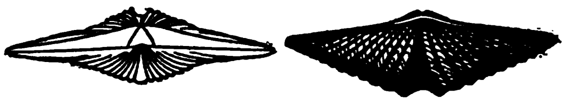


Fig. 63. Fig. 64.

This only differs from *S. mucronata* in the larger area of the ventral valve, as shewn in Fig. 60, and from *S. bimesialis* by the absence of the median rib in the sinus, and no groove on the mesial fold.

I do not pretend to decide that the above all belong to one species, or that they should be all referred to *S. varicosa*. There are numerous species of brachiopoda described by Prof. Hall and others, without figures or measurements, which never can be recognized or identified except by the persons who have the original specimens in their possession.

SPIRIFERA DUODENARIA.—(Hall.)

DELTHYRIS DUODENARIA.—Hall. *Geology of the 4th District of New York, p.* 17. *Fig.* 5. 1843.

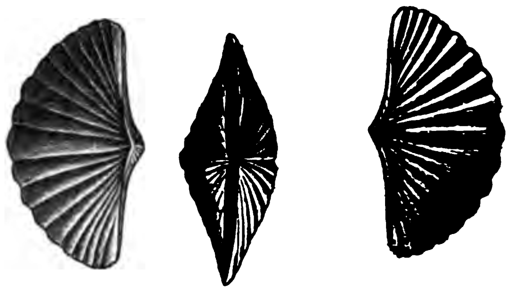


Fig. 65. Fig. 66. Fig. 67.

Fig. 65. SPIRIFERA DUODENARIA.—(Hall.) Dorsal view of a large specimen.
Fig. 66. Shews the narrow area and the close approximation of the beaks.
Fig. 67. Dorsal view.

Description.—This species is distinguished by its smooth rounded ribs. The form is sub-semicircular or sub-triangular; the hinge-line straight extended, equal to the greatest width of the shell; both valves moderately convex; the dorsal valve usually flattened or concave near the cardinal extremity; the areas very narrow; beaks small, short, pointed, incurved, nearly in contact with each other. From twelve to fourteen strong rounded ribs, gradually decreasing in

size from the middle of the shell outwards, the grooves between them rounded. Surface usually smooth, but when well preserved, with fine concentric striæ. The mesial sinus is represented by the middle furrow of the ventral valve, and the fold by the middle rib of the dorsal.

The ordinary width of this species is ten or twelve lines on the hinge line, but some are sixteen lines. In a specimen of this latter size the area of the dorsal valve is scarcely half a line high, and that of the ventral valve two-thirds of a line. The former lies nearly in the plane of the margins of the shell, while the latter slopes a little outwards. The beak of the ventral valve is incurved so as to project a little over the plane of the area, and its point is within half a line of the umbo of the dorsal valve.

This species may be easily distinguished from *S. mucronata* and *S. varicosa*, by the form of the ribs, which are round instead of angular, twice the size of those of the other species, and separated by rounded grooves. The mesial groove or sinus is only slightly larger and more conspicuous than those next it on each side.

Locality and Formation.—Rama's Farm near Port Colborne. Near Woodstock.

Collectors.—A. Murray, E. Billings.

SPIRIFERA FIMBRIATA.—(Conrad.)

DELTHYRIS FIMBRIATA.—Conrad. *Journal of the Academy of Natural Sciences of Philadelphia*, Vol. VIII., p. 263.

Fig. 68.

Fig. 69.

Fig. 70.

Fig. 68. *Spirifera fimbriata.*—Conrad. Dorsal view. Fig. 69. Side view.
Fig. 64. Ventral view.

Description.—Transversely oval; hinge line shorter than the greatest width of the shell; cardinal angles rounded; mesial fold and sinus moderately rounded; from three to eight obscure ribs on each side;

width from nine to eighteen lines; length a little more than half the width.

The dorsal valve is moderately and pretty uniformly convex, gently or not at all depressed towards the cardinal angles; area, sub-linear, lying nearly in the plane of the lateral margins, not reaching the extremities of the hinge line; beak, small pointed, scarcely at all projecting over the area; mesial fold, rounded, not prominent, extending quite to the point of the beak; usually a large space at the cardinal angles, and extending thence along the hinge line to the sides of the beak without ribs; the latter in general obscure, rounded, not much elevated, and becoming obsolete before reaching the hinge line.

Ventral valve rather strongly convex in the upper half, the outline in a side view forming about one quarter of a sphere; the beak small, pointed, and incurved over the area; the latter shorter than the hinge line, sloping outwards at an angle of about 115° at its base with the plane of the lateral margins, above rather strongly incurved; foramen broad, and with a sharp ridge on each side, not always preserved. The mesial sinus is rounded or sub-angular, and extends quite to the point of the beak; a smooth space at the cardinal extremities as in the dorsal valve.

Surface of the perfect specimens beautifully ornamented with shallow rounded concentric furrows, from three to four in two lines, the ridges between the furrows having from five to eight small elongated tubercles in the width of one line.

Locality and Formation.—Occurs in the Corniferous Limestone at Rama's Farm, and at many places in the County of Haldimand. Also in the Hamilton Shales in the Township of Bosanquet. Good specimens rare.

Collectors.—J. DeCew, E. Billings, A. Murray.

SPIRIFERA RARICOSTA.—(Conrad.)

DELTHYRIS RARICOSTA.—Conrad. *Journal of the Academy of Natural Sciences of Philadelphia,* Vol. VIII., p. 262. Pl. 14, fig. 18. 1839.

DELTHYRIS UNDULATUS.—Vanuxem. *Geology of the Third District of the State of New York,* p. 132, fig. 3. 1842.

Description.—Sub-quadrate, sub-semicircular or oval; hinge-line equal to the greatest width of the shell or a little less; dorsal valve with five, and ventral valve with six, large rounded or sub-angular ribs;

Fig. 71. Fig. 72. Fig. 73.

Fig. 71. *Spirifera raricosta.*—Conrad. Dorsal view. Fig. 72. Side view.
Fig. 73. Ventral view of a specimen with the shell exfoliated.

length of full grown individuals about one inch; width equal to or a little greater than the length.

The dorsal valve is most convex in the middle and more or less flattened or concave towards the cardinal angles; the area narrow sub-linear; the beak small pointed and together with the area strongly incurved over the hinge line; the middle rib corresponding to the mesial fold of an ordinary *Spirifera* is usually very prominent, rounded or sometimes a little flattened on the top; its width at the front margin, in a specimen fourteen lines wide, is about five lines, and it is well defined and prominent all the way to the point of the beak; the ribs next to it on each side, also reach the beak, but the two outer ribs become obsolete on approaching the hinge-line.

The ventral valve is most gibbous in the upper half, the umbo rather small but prominent, and the cardinal angles not flattened. The area is somewhat variable in its dimensions; and cannot be seen when the shell has been compressed; in large perfect specimens it is two lines high at the beak and half a line at the cardinal angles, and slopes outward at one angle of about 100° at its base, but is more or less arched towards the dorsal valve, so that its general direction is more nearly in the plane of the lateral margins. The beak is small pointed, always incurved over the area; the mesial furrows and four of the ribs extend quite to the point of the beak; the mesial furrow in all the specimens that I have seen is broadly rounded, while the lateral furrows are somewhat angular in the bottom.

The surface is usually covered with small lamellose, somewhat rough ridges of growth; but in the more perfect specimens with fine imbricating concentric lines, of which there are from four to eight in one line; all of these are undulated upwards in crossing the ribs.

The specimens vary in form from oval (those with a short hinge-line) to sub-quadrate or sub-semicircular.

This species is easily recognized even in fragments by its large rounded ribs. When partially exfoliated the ribs sometimes exhibit from one to three large rounded knobby prominences. In general, however, they are smooth.

Locality and Formation.—Near Port Colborne, and various places in the County of Haldimand.

Collectors.—A. Murray, J. DeCew, E. DeCew, E. Billings.

SPIRIFERA GREGARIA.—(Clapp.)

SPIRIFER GREGARIA.—Hall. *Tenth Annual Report of the Regents of the University of New York*, p. 127, 1857.

Fig. 74. Fig. 75. Fig. 76.

Fig. 74. *Spirifera gregaria.*—Dorsal view. Fig. 75. The same.—Side view. Fig. 76. Ventral view.

Description.—Shell semi-oval or sub-globular, varying greatly in the amount of the convexity. Hinge-line straight, equal to the greatest width of the shell; cardinal angles sometimes rounded. Ventral valve very convex, strongly and uniformly arched from beak to front, the outline sometimes forming a semi-circle; a deep angular mesial sinus extending from the front to the beak, on each side of which there are from seven to nine ribs. Umbo very much elevated, beak strongly incurved; area concave, next to the hinge-line inclining outwards at an angle of 45° to the plane of the lateral margin, but above suddenly arched over the hinge-line by the strong incurvation of the beak. Dorsal valve convex, with a strong mesial fold either somewhat angular or a little flattened along the ridge, or obscurely marked with an indistinct groove; seven to nine ribs on each side surface, often nearly smooth but sometimes marked with concentric zigzag lines. Width about three-fourths of an inch; length varying from a little less to a little more than the width.

In very convex specimens the umbo of the ventral valve is so

greatly developed that it rises above the hinge-line to a height equal to nearly one-half the length of the whole valve. Sometimes the beak of the ventral valve is incurved down nearly to the dorsal umbo, but in general there is a space of about half a line intervening.

Locality and formation.—This species has been found rather common on lot 43, concession 2, township of Middleton, in the Corniferous Limestone. According to Prof. Hall, it occurs "in the limestone of the Upper Heldenberg, (Onondaga and Corniferous) rarely in Eastern New York, common in Genesee and Erie counties, and in Ohio and Kentucky, in the same geological position."

I am indebted to Dr. B. F. Shumand for specimens from the Falls of the Ohio for comparison. These are more convex than any of ours, but of about the same size.

Collector.—J. De Cew.

SPIRIFERA PARRYANA.—Hall.

SPIRIFER PARRYANUS.—(Hall.) *Geology of Iowa*, Vol. I., page 509. Plate 4, fig 8 *a*, 6.

Fig. 77.

Fig. 78.

Fig. 77. *Spirifera parryana.*—Dorsal view. Fig. 78. Side view of the same.

Description.—Transversely sub-elliptical or sub-quadrate; cardinal angles generally rounded; sides and front angles rounded; front margin somewhat straight or a little concave for about one-third the width in the middle. Both valves rather strongly convex, giving a sub-globose form to the whole shell; mesial fold and sinus rounded, and extending to the beaks. Area of ventral valve somewhat arcuate, and forming an angle of about 48° to the plane of the lateral margins. Surface with about eighteen flat, rounded ribs, separated by grooves one-fourth the width of the ribs; mesial fold and sinus not ribbed.

Width from one inch and a half to two inches. Length about five-sixths of the width.

Locality and formation.—Lowe's Mill, township of Bosanquet, Hamilton Shales.

Collector.—The only specimen found was collected by C. Robb, Esq., C. E.

SPIRIFERA SCULPTILIS ?—(Hall.)

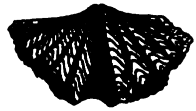


Fig. 79.

The above figure represents an imperfect ventral valve (found by Mr. Robb along with *S. Parryanus,*) which appears to be identical with the species figured by Hall in the *Geology of New York,* Vol. IV., p. 202, under the name of *S. sculptilis.*

Genus CYRTIA.—(Dalman.)

Generic Characters.—Shell semi-circular or triangular; ventral valve extremely prominent and of a pyramidal shape; area large, usually incurved; foramen extending quite to the beak, closed except a small aperture near the beak by a convex deltidium. Dorsal valve flat or only moderately convex. The internal characters do not appear to differ greatly from those of *Spirifera.*

The shells of this genus are smaller in general than *Spirifera,* and the species are closely allied to each other.

CYRTINA is another genus exactly resembling *Cyrtia* in shape, but with the interior of the ventral valve divided by a mesial septum, which supports near the foramen a triangular chamber as in *Pentamerus.*

Not having seen the interior of the two following species, I leave them in the genus *Cyrtia* where they have been hitherto placed.

CYRTIA HAMILTONENSIS —(Hall.)

CYRTIA HAMILTONENSIS.—Hall. *Tenth Annual Report of the Regents of the University of the State of New York,* p. 166. 1857.

Description.—" Shell more or less obliquely triangular, pyramidal: hinge equalling the greatest breadth, and obtusely (or acutely) ar-

Fig. 80. Fig. 81. Fig. 82.

Fig. 80.—CYRTIA HAMILTONENSIS.—Hall. Ventral view.
Fig. 81.—Side view.
Fig. 82.—Dorsal view. (The perforation not shewn near the beak in the figure, but exists in the specimen.)

gular at the extremities; dorsal valve depressed, nearly flat; beak scarcely elevated above the hinge-line; mesial fold small, bounded on each side by deeper and wider grooves than those between the plications, with sometimes a faint, narrow, longitudinal depression in the middle; ventral valve very convex, most prominent near the beak, which is very variable in elevation, and either straight or a little arched from the hinge, sometimes twisted on one side; sinus distinct, rounded or angular; area variable, triangular, generally high, often wider than high, arcuate or plane, finely striate in both ways, the vertical striæ scarcely visible; foramen very narrow, usually perforate above by an ovate aperture, and has at its base a small transverse arcuate slit. Surface ornamented by six to eight simple rounded plications on each side of the mesial fold and sinus, and marked by very fine concentric lines of growth. Under a good lens, minute granules may be seen on all parts of the exterior except the area and deltidium: interior minutely punctate."—(*Hall. Tenth Regents' Report*, above cited.)

Our specimens agree so exactly with the above description, that there can be no doubt of the identity of the species.

Locality and formation.—Townships of Bosanquet and Plympton. Hamilton shales.

Collectors.—A. Murray, J. Richardson, E. Billings.

CYRTIA ROSTRATA.—(Hall.)

A species of *Cyrtia* occurs in the Corniferous Limestone, only differing from *C. Hamiltonensis* in having the ribs larger and the surface marked with concentric imbricating lamellæ, instead of fine striæ. The only perfect specimen I have seen has five ribs on each side of the mesial fold and sinus. It is referred to *C. rostrata* provisionally.

Locality and formation.—Lot 45, Con. 1, Cayuga.

Collector.—J. De Cew.

Genus Atrypa.—(Dalman.)

Spirigerina.—D'Orbigny.

Generic characters.—Shell circular, ovate or sub-quadrate. Ventral valve with a small closely incurved or sometimes elevated beak. Surface smooth, striated, or with small ribs, and often strongly marked with concentric squamose lines of growth. Shell structure fibrous, impunctate. The spiral appendages are placed with their bases flat upon the inner surface of the ventral valve, and their apices directed into the hollow of the dorsal valve. In the interior of the ventral valve, the divaricator muscular scars occupy a large oval space in the upper half; the occlusor a much smaller circular or oval space near the beak, and inserted, as it were, between the others on rostral side In the dorsal valve the occlusors are four in number near the beak, two on each side of an obscure median ridge.

In fig. 83, a specimen of *A. reticularis* is represented lying on the ventral valve, the dorsal valve uppermost, shewing the position of the internal spires. The figure is taken from "Sandberger's Atlas."

Fig. 83.

Atrypa reticularis.—(Linn.)

Atrypa reticularis.—*Of the generality of Authors.*

Atrypa impressa.—Hall, *Tenth Annual Report of the Regents of the University of New York*, p. 122.

Fig. 84.

Fig. 85.

Fig. 86.

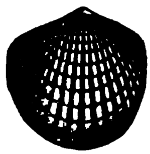


Fig. 87.

Fig. 84.—*Atrypa reticularis.*—Dorsal view. Fig. 85.—Side view.
Figs. 86 and 87.—A specimen with coarse ribs.

Description.—This species is variable in form (as are all that range through a number of formations). Specimens the size of those above figured are ovate; length a little greater than the breadth; sometimes both valves nearly equally convex, but in general the ventral valve is convex in the middle portion of the upper two-thirds, flattened to-

s the sides, and with a broad shallow mesial depression towards ront. The dorsal valve is in general strongly convex; the hinge mities rounded. The umbo and beak of the ventral valve are l, the latter sometimes a little elevated, but in general closely in- d.

rge specimens, twice the size of those above figured, are not un- non in the Corniferous limestone. These are more elongate oval, metimes, owing to the wide straight hinge-line and projecting car- extremities, the form is sub-triangular.

e surface is covered with small radiating ribs, usually two or in the width of one line. These are crossed by undulating con- ic lines of growth, which give to the ribs a nodose or rugged aspect. rge specimens from the Devonian rocks of the Hudson Bay pany's Territory, the striæ are much finer, there being four or n one line. In others they are much stronger. The shell when lly exfoliated, exhibits a whitish silken or pearly lustre. Indi- ls are sometimes found with the surface around the front margin ed with imbricating concentric lamellæ. Length usually about nch or a little less, sometimes three inches.

cality and Formation.—This species ranges from the base of lle Silurian to the Devonian, and is found in most countries e these rocks have been recognized. In Canada West it occurs merous localities in the Clinton, Niagara, Oriskany, Corniferous, Hamilton formations.

Genus STRICKLANDIA.—(Billings.)

CKLANDIA.—(Billings.) *Canadian Naturalist and Geologist,* Vol. 4, p. 132, April, 1859.

SELÆRIA.—(Hall.) part. *Twelfth annual Report of the Regents f the State of New York,* p. 39, October 1859.

neric Characters.—Shell, usually large, elongate-oval, transversely or circular, sometimes compressed; valves nearly equal; a short l septum in the interior of the ventral valve, supporting a small gular chamber beneath the beak as in *Pentamerus;* in the dorsal no longitudinal septa spires or loop yet observed; the whole e internal solid organs, (so far as is yet known) consisting of two short or rudimentary socket plates, which support prolonged ed processes for the support of the cirrated arms. In all the

species known, the ventral valve has an area more or less developed. The valves articulate by teeth and sockets.

The genus *Rensselæria* (Hall) is closely allied to *Stricklandia*, the shells being of nearly the same shape and size. Prof. Hall has shewn that in the dorsal valve the calcified processes, in his genus, after being prolonged about two-thirds the length of the valve, are united so as to form a loop, (as in *Centronella*) with a backward projecting spine. I think it probable that when better specimens are procured, it will be found that *Stricklandia* has a similar loop. In *Rensselæria* there is no triangular chamber in the ventral valve.

This group of shells, (*Stricklandia*), although closely related to *Pentamerus*, differs from that genus in the following particulars:—1st. In *Pentamerus* the form is globular and the ventral valve much the largest. In *Stricklandia* the valves are nearly equal in size, and the form oval or heart-shaped, never globose. 2nd. In *Pentamerus* the dorsal valve has two and sometimes three well developed longitudinal septa, which in most of the species sustain a small triangular chamber, as in the ventral valve. In *Stricklandia* these septa are not developed, and the triangular chamber is entirely absent. It might be thought that the difference between the short or rudimentary socket-plates of *Stricklandia*, and the elongated mesial septa of *Pentamerus* should not be regarded as of sufficient importance to constitute a generic distinction, because it is only a difference in the extent to which identical parts are developed, the socket-plates of the former genus being a rudimentary state of the latter. When, however, we examine any group of closely allied genera, we find that all the grounds for separation consist in the various modifications of the same set of organs. The difference in the degree of the development of an organ is not always a good character, but when it is carried to such an extent that the whole form of the animal is affected in a particular manner, manifested in a number of species, then it becomes of generic value. If we take the several species of *Stricklandia* and compare them with the ordinary forms of *Pentamerus*, such for instance as *P. Knightii*, *P. galeatus*, *P. Sieberi*, *P. acutolobatus*, *P. caduceus*, &c., the difference in the external form of the two groups is so remarkable, that we would almost be warranted in separating them into two genera upon this ground alone; but when to the dissimilarity in the general form we add the difference in the internal structure, then there can be little doubt as to the correctness of the separation.

The following figures exhibit the difference between the generic forms of *Stricklandia* and *Pentamerus*.

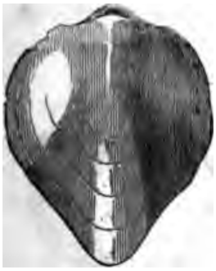


Fig. 88.

Fig. 89.

Fig. 90.

Fig. 88.—*Stricklandia lens*, dorsal view.
Fig. 89. The same side view, shewing that the valves are nearly equal in size.
Fig. 90.—*Pantamerus Knightii*, side view shewing the great difference in the size of the valves.

This genus ranges from the Middle Silurian up to the Devonian. It includes three English species long known under the names of *Pentamerus lens*, *P. liratus*, and *P. lævis*. In Canada we have these three in the Clinton group at Anticosti, and also *Stricklandia Gaspensis*, (Niagara group) Gaspé, *S. Canadensis* (Clinton group) Thorold, C. W., *S. brevis*, perhaps a variety of the latter (Clinton) Anticosti. *Stricklandia elongata* is the only species known to me in the Devonian rocks.

STRICKLANDIA ELONGATA. (Vanuxem.)

PENTAMERUS ELONGATUS.—(Vanuxem.) *Geology of the Third District of the State of New York*, p. 132 1842.

PENTAMERUS ELONGATUS.—(Hall.) *Geology of the Fourth District of the State of New York*, No. 34, Fig. 1.

MEGANTERIS ELONGATUS.—(Hall.) *Tenth Annual Report of the Regents of the University of the State of New York*, p. 123. 1857.

RENSSELÆRIA ELONGATA.—(Hall.) *Twelfth Annual Report of the Regents of the University of the State of New York*, p. 38. October, 1859.

Description.—Elongate-oval, somewhat variable in form, the sides convex, as in the above figure, or nearly straight and parallel, and in the latter case the front truncated or nearly straight. Valves varying in the amount of their convexity, sometimes nearly cylindrical above

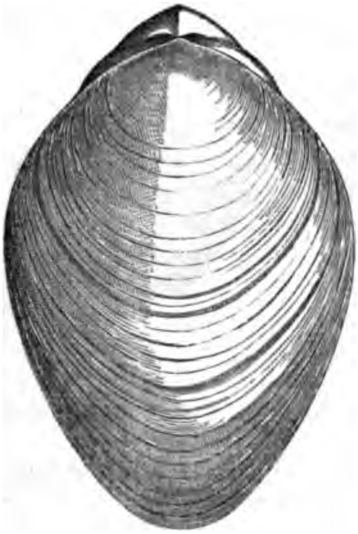


Fig. 92.

Fig. 91.

Fig. 91. *Stricklandia elongata.*—(Vanuxem.) Dorsal view of a specimen of a more nearly oval shape than usual.

Fig. 92. The same, interior of ventral valve, shewing the small triangular chamber beneath the beak.

and compressed towards the front; the ventral valve in general the most convex, obtusely carinated from the beak along the middle in the upper half; the dorsal valve in the upper half often much flattened and broadly carinated in the middle, sometimes evenly convex. In many specimens the sides are abruptly compressed, so that a transverse section through both valves would be somewhat hexagonal in outline. The beak of the ventral valve is closely incurved over the umbo of the dorsal valve. Surface smooth but usually with several rough concentric imbricating ridges of growth most strongly developed towards the front.

Length from two to three or even four inches; width from one half to two-thirds of the length.

This appears to me to be a variable species, many of the specimens being somewhat broadly-oval, while others are elongate-oval or sub-cylindrical. So great are these differences that, without the intermediate forms, the extremes might readily be classified as distinct species. The specimens are seldom found perfect.

Locality and Formation.—At most localities of the Devonian rocks in the County of Haldimand, Oriskany Sandstone, and Corniferous Limestone.

Collectors.—E. DeCew. J. DeCew. E. Billings.

Genus PENTAMERUS.—(Sowerby.)

Generic Description.—Shell, globular or sub-globular, the ventral valve the larger, and usually with a prominent, greatly developed umbo. A strong mesial septum in the interior of the ventral valve, supporting a triangular chamber beneath the beak. "In the interior of the smaller (or dorsal valve) there are two distinct longitudinal septa, of variable dimensions; (between which a small median ridge is occasionaly found), to these the socket walls converge and join, forming two more or less developed and inclined plates, to the produced extremities of which were affixed the spiral cirrated arms." (Davidson, Introduction, p. 98.)

This genus ranges from the base of the Trenton Limestone up to the carboniferous rocks.

PENTAMERUS ARATUS.—(Conrad.)

ATRYPA ARATA and ATRYPA OCTOCOSTATA.—(Conrad.) *Annual Report on the Palæontology of New York*, p. 55, 1841.

PENTAMERUS ARATUS.—(Hall.) *Tenth Annual Report of the Regents of the University of the State of New York*, p. 120, 1857.

Fig. 93.

Fig. 94.

Fig. 93.—*Pentamerus aratus*, Dorsal view of a very large specimen.
Fig. 94.—Side view of the same specimen.

Description.—Shell, varying greatly in size and shape, ovate or sub-triangular, very convex or irregularly sub-globular. In large specimens the ventral-valve is very convex, with an exceedingly prominent and tumid umbo; the outline on a side-view is strongly arched from the beak to the front, the most rapid curvature being in the upper half; the beak is incurved, but not in contact with the umbo of the dorsal valve; a broad shallow mesial sinus originates at the front margin and becomes narrower and shallower, until, at length, it dies out before reaching the beak; in a front view the outline is sub-triangular. In small specimens the umbo and beak are proportionally much smaller, the form more nearly oval or nearly circular, and the mesial sinus occasionally obsolete. The dorsal valve is much the smaller, depressed convex, with a broad, slightly elevated mesial fold, on each side of which the shell is usually a little flattened, or even slightly concave; the mesial fold sometimes not at all developed. The surface is covered with coarse, unequal, sub-angular, or obscurely rounded ribs, from one line to one line and a half in width. These ribs increase in number from the beak towards the front, both by sub-division and the insertion of smaller ones between the larger. On each side of the beak there is a smooth space.

The only difference between this species and the well-known *Pentamerus galeatus* appears to be that, in the latter, the mesial sinus is on the dorsal and the fold upon the ventral valve.

In the following figures a small specimen is represented.

Fig. 95.

Fig. 96.

Locality and Formation.—This species occurs in the Oriskany Sandstone, and Corniferous Limestone, in various places in the County of Haldimand.

Collectors.—J. DeCew. E. DeCew. E. Billings.

Genus CENTRONELLA.—(Billings.)

CENTRONELLA.—Billings. *Canadian Naturalist and Geologist*, Vol. IV., p. 131. April, 1859.

Generic characters.—Shells, having the general form of *Terebratula*. Dorsal valve with a loop consisting of two delicate riband-like lamellæ, which extend about one-half the length of the shell. These lamellæ at first curve gently outwards, and then approach each other gradually, until at their lower extremities they meet at an acute angle; then becoming united they are reflected backwards towards the beak, in what appears to be a thin, flat, vertical plate. Near their origin each bears upon the ventral side a single triangular crural process.

This genus appears to stand between *Terebratula* and *Waldheimia*. In the former, the loop is short, not exceeding greatly one-third the length of the shell, and not reflected. In the latter, it extends nearly to the front, and is reflected, but the laminæ are not united until they are folded back.

CENTRONELLA GLANS-FAGEA.—(Hall.)

RHYNCONELLA GLANS-FAGEA.—Hall. *Tenth Annual Report of the Regents of the University of the State of New York*, p 125. 1857.

Fig. 97.

Fig. 97.—*Centronella glans-fagea.* Three views of a specimen of the usual size. These figures are too much rounded at the sides.

Description.—Shell smooth, ovate or sub-rhomboidal, greatest width about the middle, from which point the sides are nearly straight in the upper half, and converge to the beak at an angle of about 85°; front half rounded, sometimes with a sinus in the front margin. Ventral valve the larger, its outline forming a nearly regular arch from the beak to the front margin, strongly and broadly sub-carinate along the middle in the larger individuals, more uniformly convex in the small ones; beak long, strongly incurved over the dorsal valve, but not in contact therewith. Dorsal valve nearly flat, with a wide, shallow, mesial sinus, which, in some specimens, occupies nearly the whole width of the shell, but in others it is almost obsolete, and the

valve is then nearly flat. Length from two to three lines, width about the same.

The above description applies to the more common form of this species. Larger individuals from six to eight lines in length are occasionally found, but they do not seem to be so numerous as the smaller ones. In these, the dorsal valve is divided along the middle by a narrow, rounded sinus, which extends from the front nearly to the beak; on each side the shell is convex, sometimes rather strongly tumid. The ventral valve broadly carinate along the middle. The following figures represent the largest specimens that I have seen in different views.

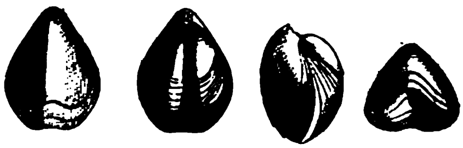


Fig. 98.

Centronella tumida ?

There are some intermediate sizes, but not sufficient to make out a series connecting these large individuals with the smaller. Should these constitute a distinct species, I propose to call it *C. tumida*.

Locality and formation.—Oriskany Sandstone and Corniferous Limestone, County of Haldimand. Also at Rama's Farm near Port Colborne.

Collectors.—J. De Cew, E. De Cew, E. Billings.

CENTRONELLA HECATE.—*N. Sp.*

Fig. 99.

Centronella Hecate.—*a.* A specimen with the dorsal valve removed, shewing the loop, which is covered with minute crystals of silex. *b.* Ventral view of another specimen. *c.* side view, *d.* dorsal view.

Description.—Elongate, oval, or sub-rhomboidal; apical angle from 45° to 60°; sides somewhat straight from the beak to about the middle, where, making a rounded angle, they converge towards the front margin, which is somewhat truncate for about one-third the width. Ventral valve strongly but broadly carinate from the beak along the middle to the front, descending with a flat or gently convex slope to

the sides; in outline only gently arched longitudinally; in some specimens nearly straight; the beak small, elongated, erect, and with a triangular foramen. Dorsal valve gently convex in the upper half, and with a wide shallow sinus in the lower half. Surface smooth. Length from two to four lines; width about three-thirds the length.

Locality and formation.—Oriskany Sandstone and Corniferous Limestone, County of Haldimand.

Collector.—J. De Cew.

CHARIONELLA CIRCE.—*N. Sp.*

Fig. 100.

Charionella Circe.—The first figure exhibits a specimen with the dorsal valve partly removed, shewing the internal spires. The other two figures are a side and ventral view of another specimen.

Description.—Elongate ovate, greatest width a little below the mid-length, above which the sides converge with a nearly straight or gently convex curve to the beak; apical angle between 60° and 75°; front half rounded, sometimes slightly truncate in the middle of the front margin. Both valves moderately and evenly convex. Ventral valve evenly arched from beak to front; beak incurved, but not in contact with the dorsal umbo, truncated by a circular aperture which is formed below by a deltidium; the sides of the umbo very obtusely sub-angular for about one-sixth of the length of the shell. Dorsal valve not quite so convex as the ventral, most prominent a little above the mid-length; the umbo moderately prominent; the shell narrowed and somewhat pointed towards the beak. Surface nearly smooth.

Length of specimen of average size—eight lines; width six lines; depth of both valves, four lines; difference between the length of dorsal and ventral valves, three-fourths of a line.

Associated with the above, are specimens of about the same length, which are proportionally broader, and with a shallow, mesial sinus extending from the front margin of the ventral valve nearly to the beak. The sides of the umbo or cardinal slopes are more angular, and the beak more prominent. The front margin, instead of being rounded, is straight, or even a little concave in the middle. These

may belong to the same species, but more specimens are required to determine this point.

Locality and formation.—Corniferous Limestone, County of Haldimand.

Collector.—J. De Cew.

Remarks on the genus Charionella.

Fig. 101.

A silicified fragment of the dorsal valve of *C. Circe* a little enlarged, shewing the absence of a regular hinge-plate.

Fig. 102.

A fragment of the ventral valve of *C. scitula?* shewing the deltidium and muscular impressions in part.

By treating partially silicified specimens of this genus with acids, I have ascertained that the structure of the hinge-plate differs from that of *Spirigera* in being either obsolete along the middle or anchylosed to the bottom of the valve. In *Athyris* = (*Meristella*, Hall) there is a well developed hinge-plate, supported beneath by a strong mesial septum, which extends sometimes nearly to the front of the valve. In *Charionella* there is either no mesial septum, or, one that is merely rudimentary. In one specimen there is a remarkable partition, which runs obliquely from near the beak to the margin near the front. It completely divides the internal cavity into two parts. This I believe to be not a mesial septum, but a temporary wall formed by disease of the animal, because both spires are crowded into the smaller of the two cavities the larger being empty.

It is probable that further researches will bring to light other characters of the hinge-plate in other species, and I do not therefore confine the genus to such as have this organ constructed exactly as in *C. Circe* and *C. scitula*.

The species figured by De Verneuil under the names of *Terebratula, Schulzii*, *T. Bordii*, and *T. mucronata*, in the Bulletin of the Geological Society of France, 2nd Series, Vol. VII., Plate 3., have the aspect of this genus, and exhibit the same structure of the beak, foramen and deltidium of the ventral valve, and most probably have the same internal organization.

(To be continued.)

NOTE ON A NEW SPECIES OF TRIARTHRUS FROM THE UTICA SLATE OF WHITBY, CANADA WEST.

BY J. F. SMITH, JR.

(Read before the Canadian Institute, 26th January, 1861.)

The specimen here figured, was discovered about two years ago, in a piece of Utica Slate from Whitby. I had previously obtained, from the same locality, a side-piece of the head of a much larger individual, but did not describe it, as the specimen was too imperfect. The fact that this genus has been altogether described from fragments, may serve as an apology for adding a new species under the same circumstances. The genus *Triarthrus* is said to differ from the genus *Olenus*, as regards the head-shield, by the facial suture of the latter genus terminating at the posterior margin of the buckler; while in the former, it terminates at the angles as in *Calymene*. I do not think that this distinction will hold good as a generic character, for in the species here figured the suture does not terminate at the angles, but at the margin, as in *Olenus*. This distinction, however, is not well represented in the accompanying figure. I propose to call this new species *Triarthrus Canadensis*, as it is the third discovered in this Province. The only other species having long spines, is *Triarthrus spinosus* (Billings). By reference to Mr. Billings' description (*Can. Geol. Survey Rep.*, 1853-54, 55, 56, page 340) the difference in *T. Canadensis* will become at once apparent. The horns of the former are slender and cylindrical, and point, with a slight curve, almost directly downwards to the eighth pair of pleuræ. In *T. Canadensis*, they are flattish, and rather thick, with a groove running down the centre, and they extend at an angle of about 40°, evidently not farther than the fourth pair of pleuræ. The specimen before mentioned, and the one here figured, are the only ones yet discovered. Good specimens are therefore likely to be rare.

Triarthrus Canadensis.

SPECIMEN OF A FLORA OF CANADA.

(Continued from page 168.)

BY WILLIAM HINCKS, F.L.S., F.B.S.E.

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I follow Dr. Lindley's classification so far as the adoption of the Alliances, the mode of sub-dividing the class Exogens, the admission of his class Dictyogens, and the general series of the orders,—excepting that as I now propose to proceed no further than the Ferns, I have reversed the arrangement so as to leave the unfinished part at the end instead of at the beginning of my work. I differ from Lindley in rejecting his class Rhizogens, which, however, does not affect the Canadian Flora, in receiving the Ferns as a class under the name of Acrogens,—the Mosses and Hepaticæ being called Anophytes,—and in deeming it useful to reduce the seven classes thus admitted under three sub-kingdoms, which may, I conceive, be best named Cryptogamæ, Monocotyledoneæ, Dicotyledoneæ. My general scheme of the vegetable kingdom would therefore stand thus:—

			SUB-KINGDOMS.		CLASSES.
Plants	with stamens and carpels	Seeds with two or more cotyldons	*Dicotyledoneæ*.....	Seeds enclosed in the carpel—the pollen acting through its tissues	I. Exogenæ.
				Seeds naked, the pollen acting directly on their surface.	II. Gymnospermæ
		Seeds with only one cotyldon.	*Monocotyledoneæ*	Leaves net-veined, deciduous; root with the wood in a solid concentric circle.	III. Dictyogenæ.
				Leaves parallel-veined, permanent; root like the stem internally.	IV. Endogenæ.
	with a lower type of the reproductive system		*Cryptogamæ*........	Developed from a prothallus containing the proper reproductive organs. Stem with woody tissue and vessels.	V. Acrogenæ.
				With stem and foliage distinct or confluent, consisting of cellular tissue only.	VI. Anophyta.
				Stem and foliage undistinguishable; of cellular tissue only.	VII. Thallophyta.

Lindley's sub-classes of Exogens stand thus :—

- Stamens and carpels ordinarily on the same flower
  - Calyx and torus adherent on the united carpels .... EPIGYNOSÆ.
  - Carpels free ; androecium adhering on the corolla, or both on the calyx ... PERIGYNOSÆ.
  - Carpels free ; outer circles all distinct .... HYPOGYNOSÆ.
- Stamens and carpels on different flowers .... DICLINOSÆ.

The following table characterizes the alliances of the sub-class Epigynosæ, which are represented in the Canadian Flora :—

Epigynose Exogens (ALLIANCES.)

- having a single envelope, or monochlamydeous .... ASARALES.
- almost constantly dichlamydeous
  - Corolla
    - Dialypetalous
      - Seeds
        - with copious albumen & small embryo
          - Seeds solitary in each carpel ; large in proportion.................. UMBELLALES.
          - Seeds numerous, minute...... GROSSALES.
        - with little or no albumen [Placentæ axile] .... MYRTALES.
    - Synpetalous
      - Embryo
        - minute, amidst copious albumen .... CINCHONALES.
        - with little or no albumen .... CAMPANALES.

The first alliance is one of the least satisfactory, the uniting characters, however important, not being accompanied by any apparent marks of affinity: Santalaceæ are not even uniformly Monochlamydeous. Aristolochiaceæ seem to approach Dictyogens.

Asarales (ORDERS.)

- Carpels 3—6, usually 6 ; causing the fruit to have as many cells, with numerous seeds... ARISTOLOCHIACEÆ.
- Carpels apparently several, but forming one cell, with few ovules, perfecting only one seed .... SANTALACEÆ.

The order Aristolochiaceæ, abounding in equinoctial South America, and occurring more sparingly in North America, Europe (especially the basin of the Mediterranean), and India, remarkable for tonic

and stimulating properties, stands first in our series, out of its 180 species giving one, or possibly two, to our Flora:

Genus 1.—Calyx regular, with the three sepals more or less separated above; stamens 12; fruit fleshy, globular, opening irregularly. Stemless herbs, with aromatic-pungent rootstocks; kidney-shaped leaves, on long petioles; and a short peduncled flower, close to the ground .... ASARUM.

" 2.—Calyx tubular, the three sepals being united almost to their tips, the border being obscurely three-lobed. Tube variously inflated above the ovary; mostly contracted at the throat. Stamens six, adnate to the short fleshy stigma, which has as many lobes or angles as there are carpels. Twining shrubs, or upright perennial herbs.. ARISTOLOCHIA.

Asarum Canadense, L. — *Wild Ginger.* — Soft-pubescent: leaves kidney-shaped, more or less pointed: calyx bell-shaped, with the upper separate portion of the acute sepals widely and abruptly spreading: brown-purple inside; stamens awn-tipped. Hill sides in rich woods: not rare. Toronto, Hamilton.

ARISTOLOCHIA SERPENTARIA may be found in Canada.

A. SIPHO is cultivated as an ornamental climber.

The order SANTALACEÆ, named from Santalum, the genus which supplies the fragrant sandal-wood of the East, has with us but one genus, Comandra Nutt.

Calyx bell-shaped, becoming urn-shaped; lined above the ovary with an adherent disk, which has a five-lobed free border. Stamens on the edge of the disk between its lobes, opposite the sepals, to the middle of which the anthers are connected by a tuft of threads. Fruit drupe-like or nut-like, the tips of the persistent sepals forming a crown, the cavity filled by the globular seed. Low and smooth perennials, with herbaceous stems from a somewhat woody base or root, alternate sessile leaves, and greenish-white flowers in small umbel-like clusters.

C. Umbellata Nutt.—Peduncles several, and corymbose-clustered at the summit of the stem: several flowered: tube of the coherent calyx extending beyond the ovary, forming a neck to the fruit: free extremities of the sepals oblong: style slender: fruit dry: root forming parasitic attachments to the roots of trees. Stems 8′—10′ high, very leafy: leaves obovate oblong, 1′ long. Common. Toronto, &c.

C. livida, Richards.—Peduncles axillary, 3–5 flowered, shorter than the oval flaccid leaves: calyx-tube not extending beyond the

ovary: free extremities of the sepals ovate: style short: fruit pulpy, when ripe red. Leaves larger than in the last. Shore of Lake Superior and Northward.

Alliance UMBELLALES, known among the Epigynose, Dichlamydeous, Dialypetalous, Exogens, by the solitary large seed in each of two or more carpels. A very natural group, and contributing considerably to our flora. The following table will distinguish our Orders, including all which belong to the alliance excepting Bruniaceæ, which are all natives of Southern Africa and Madagascar:—

ORDERS.

Umbellales-Fruit
- not didymous — Leaves
  - opposite [without stipules; flowers tetrameous; corolla valvate] ... CORNACEÆ.
  - alternate
    - with stipules [anthers with deciduous valves, corolla imbricate] ... HAMAMELIDACEÆ.
    - without stipules,—anthers opening inwards; corolla valvate ... ARALIACEÆ.
- didymous, with a double disk; ripe carpels, separating from below [the fruit called a cremocarp] ... APIACEÆ.

Hamamelidaceæ.—A small order, consisting of shrubs or low trees, chiefly found in Asia or South Africa; but of which one species is widely diffused in North America; another of a different genus occurring in the Southern U. S.

Hamamelis, L.

Flowers in axillary clusters or heads, usually surrounded by a scale-like three-leaved involucre. Cal. of four sepals, with two or three bractes at its base. Petals four, strap-shaped, long and narrow, spirally involute in the bud. Stamens eight, four alternating with the petals, anther-bearing; the others imperfect, scale-like. Carpels two, with short styles. Pod opening from above loculicidally; bursting elastically into two pieces. Shrubs with straight-veined leaves, and yellow perfect or polygamous flowers.

H. Virginica, L.—*The Witch Hazel.*—Leaves obovate or oval, wavy-toothed, somewhat downy when young. Shrub, blossoming late in autumn, when the leaves are falling, and maturing its seeds the next summer. Common in Canada, Toronto, &c.

Cornaceæ.—A small order, consisting of trees and shrubs, with a few herbs, known by their generally opposite, exstipulate leaves,

tetramerous flowers with valvate æstivation, and fruit of two or more coherent single-seeded carpels, with the calyx adherent. Referring Nyssa (which, however, is not a Canadian genus) to Alangiaceæ among the Myrtales, Cornus is our only genus, of which we have seven species out of 20 which are known.

§ 1.—Flowers greenish, collected in a head or close cluster, which is surrounded by a large showy 4-leaved corolla-like white involucre. Fruit bright red.

1. CANADENSIS, L.—*Dwarf Laurel: Bunch-berry.*—Stems low and simple (5′—7′ high), from a slender, creeping, and subterranean rather woody trunk. Leaves scarcely petioled; the lower scale-like, the upper crowded into an apparent whorl in sixes or fours, ovate or oval-pointed; involucral leaves ovate; fruit globular. Woods: common in Canada—Toronto, Montreal. June.

2. C. FLORIDA, L.—*Flowering Dogwood.*—Leaves ovate, pointed, somewhat acute at the base; involueval leaves inversely heart-shaped or notched (1½′ long); fruit oval; a tree 12°—30° high. Western Canada, rare; Hamilton. May and June.

§ 2.—Flowers white, in open and flat spreading cymes: involucre none: fruit spherical.

* *Leaves all opposite.*

3. C. CIRCINATA, L'Her.—Branches, greenish warty-dotted; leaves round-oval, abruptly pointed, woolly underneath (4′—5′ broad): cymes flat: fruit light blue. Shrub 6°—10° high. Copses: not uncommon—Toronto, Hamilton, Montreal. June.

4. C. SERICEA, L.—Branches purplish: the branchlets, stalks, and under surface of the narrowly ovate or elliptical pointed leaves, silky-downy (often rusty), pale and dull: cymes flat, close: calyx-teeth lanceolate: fruit pale blue: flowers yellowish-white. Wet places, common—Toronto, Montreal. June.

5. C. STOLONIFERA, Michx.—*Red Osier.*—Branches, especially the osier-like annual shoots, bright red-purple, smooth: leaves ovate, rounded at the base, abruptly short-pointed, roughish, with a minute close pubescence on both sides, whitish underneath: cymes small and flat, rather few-flowered, nearly smooth: fruit white or lead-colour.

increasing by prostrate or subterranean suckers, so as to form large dense clumps 3°—6° high. Wet places and by streams, common—Toronto, Hamilton, Montreal.

6. C. Paniculata, L'Her.—Branches gray, smooth: leaves ovate-lanceolate, taper-pointed, acute at the base, whitish but not downy beneath: cymes convex, loose, often panicled: fruit white, depressed, globose: 4°—8° high, much branched, bearing a profusion of pure white blossoms. Thickets—Toronto, Hamilton.

** *Leaves mostly alternate, crowded at the end of the branches.*

7. C. Alternifolia.—Branches greenish, streaked with white alternate leaves, ovate or oval, long-pointed, acute at the base, whitish, and minutely pubescent underneath: fruit deep blue. Shrub or tree 8°—20° high, generally throwing its branches to one side in a flattish top, and with broad very open cymes. Copses, not uncommon—Toronto, Hamilton, Montreal.

C. Florida deserves culture for its beauty. The barks of *C. Florida*, *circinata*, and *sericea* are counted amongst the best tonics of North America.

Araliaceæ.—An order very closely allied to *Apiaceæ*, but the fruit, usually consisting of more than two carpels, even when reduced to two, is not a cremocarp, nor is there ever a double epigynous disk. The plants are generally stimulant and aromatic. Many of the species are woody. The number of species recorded is 160, contained in 21 genera, of which we have five species usually referred to two genera, though Dr. Gray reduces them to one. The reduced number of carpels in Panax, with the increased tendency to the suppression of one circle of the essential organs, seems to me to justify retaining the genus.

Carpels	Styles 2—3: flowers diœciously polygamous [sepals completely adherent]	Panax.
	Styles 5: flowers perfect or monœciously polygamous [apices of the sepals free, forming five short calyx-teeth]	Aralia.

Panax, L.—*Wild Ginseng.*

1. P. Quinquefolium, L.—*False Ginseng.*—Root spindle-shaped, often forked, 4′—9′ long, aromatic: stem 1° high: leaflets long-stalked, mostly five, large and thin, obovate-oblong, pointed; styles

mostly two: fruit red. Rich mountain woods—July—Montreal, Dr. Holmes; Hamilton. Sent from the United States to China, as a substitute for the true Ginseng.

2. P. TRIFOLIUM, L.—*Dwarf Ginseng: Ground Nut.*—Root globular, deep in the ground, pungent, not aromatic: stem 4′—8′ high: leaflets 3—5, sessile at the summit of the leaf-stalk, narrowly oblong, obtuse: styles usually three: fruit yellowish. Woods—May and June—Toronto, Hamilton.

Aralia, L.—*Spikenard—Wild Sarsaparilla.*

1. A. RACEMOSA, L.—*Spikenard.*—Herbaceous: stem widely-branched: leaflets heart-ovate pointed, doubly-serrate, slightly downy: umbels racemose-panicled: styles coherent below. Rich Woodlands—July—Toronto, Hamilton, Montreal.

1. A. NUDICAULIS, L.—*Wild Sarsaparilla.*—Stem scarcely rising above the ground, with a single long-stalked leaf and a shorter naked scape, with 2—7 umbels: leaflets oblong-ovate or oval, pointed serrate, five on each of the three divisions. The aromatic horizontal roots used as a substitute for sarsaparilla. Moist woods—May and June—Toronto, Hamilton, Montreal.

A. hispida, Michx.—*Bristly Sarsaparilla.*—Stem 1°—2° high, bristly, leafy, terminating in a peduncle bearing several umbels: leaves twice pinnate, leaflets oblong-ovate acute, cut-serrate. Rocky places—June—Three Rivers, Dr. Holmes.

Hedera helix (the Ivy) and *Adoxa Moschatellina* (the Muscadel) are the European representatives of this order. *Aralia spinosa* (the Angelica tree) grows as far north as Pennsylvania, and is cultivated.

I conclude this specimen by giving a tabular view of the alliances of *Perigynose Exogens*, and of the orders in one alliance, selected for its important relation to our flora:

ALLIANCES.

ose
is

- **Corolla**
  - Dyalypetalous, or absent
    - **Carpels**
      - More or less distinct, or (by abortion) solitary [embryo amygdaloid, with little or no albumen]* .... ROSALES.
      - consolidated
        - each carpel having its ovules
          - **Embryo**
            - amygdaloid, with little or no albumen .... RHAMNALES. [seeds definite: placentæ axile: trees or shrubs]
            - taper, with little or no albumen .... SAXIFRAGALES. [seeds numerous: with us all herbs]
        - so as to appear single,† two or more carpels producing but one ovule
          - **Embryo**
            - external curved around a small mealy albumen FICOIDALES. [herbs: fruit a utricle, enclosed in the hardened calyx]
            - amygdaloid, with little or no albumen] .... DAPHNALES. [low trees or shrubs]
  - Synpetalous
    - **Fruit**
      - Nucumentaceous‡ .... ECHIALES. [Embryo large, with little or no albumen]
      - a capsule, or berry
        - **Placentis**
          - free central .... CORTUSALES. [embryo with a copious albumen: flowers symmetrical]
          - not free central, or very rarely so, and have exalbuminous
            - **Embryo**
              - minute, or the cotyledons smaller than the radiate, amidst copious albumen .... GENTIANALES. [shrubs or herbs, with undivided, often opposite, leaves, without stipules]
              - large, lying in a small quantity of albumen .... SOLANALES. [exterior circles of the flower symmetrical: placentæ white]
              - with little or no albumen .... BIGNONIALES. [unsymmetrical: generally irregular]

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* The Rosal alliance, though a very natural one, is not easily defined, so as to remove the ubts of the inexperienced. Rosa itself, in which the torus bearing the numerous distinct rpels, lines the coherent lower portion of the calyx, producing from its border the petals

[*See over.*

† The character here employed does not apply to all Ficoidals, but belongs to the only ler of the alliance of which there is an example in our Flora. The plants of this division described as having a single carpel; but Dr. Lindley, though using the ordinary language, ints out the probability that the fruit is formed by a union of carpels; and after examing many cases, I am so convinced of the correctness of this view that I do not hesitate to opt it.

‡ The nucumentaceous fruit consists of one-seeded nuts, or of clusters of them, separate or parable In the orders Boraginaceæ and Lamiaceæ, the so-called four nuts evidently long to two carpels, each having a single seed at each side, so that there are two united yles and two more or less distinguishable stigmas.

ORDERS. — SUB-ORDERS.

- Rosales — Flowers
  - Dialypetalous — Carpels
    - Several
      - in one circle, adhering to the synsepalous calyx by their backs, and thus bound together so as to imitate an inferior fruit .... POMACEÆ.
      - in one or more circles, usually numerous, almost always distinct .... ROSACEÆ. — Torus
        - nearly on the level of the flower SPIRÆIDÆ.
        - lining the tube of the synsepalous calyx......... ROSIDÆ.
        - covering a projection of the axis.................. POTENTILLIDÆ
    - Solitary — Fruit
      - a drupe [flowers always regular] ... AMYGDALACEÆ.
      - a legume [flowers mostly irregular—always in our species] .... FABACEÆ.
  - Apetalous [with the single carpel enclosed in the hardened calyx tube] .... SANGUISORBACEÆ.

SELECTED ARTICLES AND TRANSLATIONS.

ON THE PRIMORDIAL FAUNA AND POINT LEVI FOSSILS.

BY JAMES HALL.

[In the January number of the *Journal* (page 40 of this volume) we inserted an interesting communication, on "The Fauna of the Quebec group of Rocks, and the Primordial Zone of Canada," addressed by the Director of our Geological Survey, SIR WILLIAM LOGAN, to M. BARRANDE. We now give some additional remarks on this subject (extracted from the last number of the *American Journal of Science and Arts*), by Professor Hall.* The age of these strata, it will be seen, is still considered by Professor Hall to be an unsettled point. His analysis

and stamens; and still more Pomaceæ, in which the calyx adheres on the backs of the single circle of carpels, and binds them together, the petals and stamens being in the same position as in Rosa, might appear to be Epigynose. Sanguisorbaceæ, with the solitary carpel enclosed in the hardened synsepalous calyx, greatly resemble such Ficoidals as Scleranthus. Many Fabaceæ would be easily taken to be Hypogynous. Yet with a knowledge of the sources of difficulty, and with the clear definition of the Orders, the careful student will soon obtain satisfaction.

* "Letter from James Hall, Palæontologist of New York, to the Editors of the *American Journal of Science and Arts*." Dated January 23rd, and published in the March number of that Journal.

of the Quebec fossils certainly presents some curious and apparently antagonistic results, as regards the assumed primordial character of the rocks in question. If, however, the fossiliferous beds of the Quebec series be not strictly "primordial," we can scarcely look upon them otherwise than as representing the base of Barrande's second zone—the original view, we believe, of Mr. Billings: or rather perhaps, as constituting beds of passage between the first and second zones, and thus linking together the Primordial and Lower Silurian formations (specially so-called)—a fact of much interest. The dark shales which underlie the Quebec group, represent probably, as surmised by Sir William Logan, the true primordial series. But if these Quebec or Point Levi strata appear thus to be somewhat higher than the actual primordial zone, their fossil contents must compel us, at the same time, to regard them as occupying a lower horizon than that of the Hudson River deposits; although it will probably be found, in the sequel, that throughout the whole of our lower fossiliferous rocks, from the earliest fossil-containing bed to the top at least of the Lower Silurian series, no strongly-marked lines of demarcation can be drawn. Professor Hall objects to the Vermont trilobites being received as evidence of the age or position of the rocks in which they occur, on the plea that these trilobites are not true *Oleni*, but belong to other genera. If this be allowed, the type is nevertheless strongly Olenian, so to say, and, as such, evidently indicative of a low geological horizon. It might be urged against this, it is true, that the genus *Triarthrus*, of the Utica Slate, belongs also to the same type; but the affinities of this latter lie, as it were, between *Olenus* and *Calymene*, an ascending type: whilst the Vermont forms hold an intermediate position between *Olenus* and *Paradoxides*. There is thus, between the two, an essential difference.—E. J. C.]

In the Twelfth Annual Report of the Regents of the University upon the State Cabinet of Natural History, I published descriptions of three species of Trilobites from the shales of the town of Georgia in Vermont, referring them to the age of the Hudson River group. These trilobites had been in my possession for some two years or more; and knowing the great interest that would attach to them, whenever published, I had waited, hoping that some new facts might be brought out touching the stratigraphical relations of these rocks in the town of Georgia.

After the descriptions had been printed and a few copies distributed, I learned that Sir William Logan was at that time actually investigating the rocks of that part of Vermont. Desiring to know the results of his latest researches in regard to the stratigraphical relations of these rocks, I withheld the final publication till the Meeting of the American Association for the Advancement of Science, in Springfield, and there showed to Sir William my descriptions as they now stand in the

Report, and I then received his authority for the addition of the note which was appended.

This in a few words is a simple history of the matter relating to the publication of these species. I made no remarks or comparisons with the primordial fauna of Barrande in Bohemia, knowing that these features would be at once recognized by every palæontologist; while their reference to the genus Olenus showed my appreciation of the nature of the fossils.

I received a copy of the communication of M. Barrande, from Sir William Logan in September, a few days before setting out for my field duties in Wisconsin. Since my return to Albany, constant and pressing occupation has left me no time to consider a reply to a question of so much importance.

Later discoveries in the limestones associated with the shales at Quebec leave no longer a doubt, if any could have been entertained before, that the shales of Georgia, Vermont, are in the same relative position; and we must regard these three trilobites as belonging to the same fauna with the species enumerated by Sir William Logan as occurring in the Quebec group. Left to palæontological evidence alone, there could never have been a question of the relations of these trilobites, which would at once have been referred to the primordial types of Barrande.

Sir William Logan yields to the palæontological evidence, and says, "*there must be a break.*" He gives up the evidence of structural sequence which he had before investigated and considered conclusive; and having heretofore relied upon the opinion of the distinguished Geologist of Canada in regard to a region of country to which my own examinations had not extended, I have nothing left me but to go back to the position sustained by palæontological evidence. Let us for a moment examine this palæontological evidence.

The identifications of the fossils of the Quebec group, certainly show a remarkable agreement between the trilobites of this group and those of the Potsdam sandstone, in the occurrence of *six species* of *Dikellocephalus* and one of *Menocephalus;* while the occurrence of many others is in agreement or not incompatible with the fauna of the Potsdam and Calciferous sandstones. The comparative values of the Trilobitic faunæ of this group and of the primordial zone of Europe, as established by Barrande, is better shown in a tabular form which I here append.

The Crustacean fauna of the primordial zone of Europe.

Paradoxides, Olenus, Peltura, Conocephalus, Ellipsocephalus,* Hydrocephalus, Sao, Arionellus	These genera are all limited to the *faune primordiale*, and none of the other European genera of trilobites are known in this fauna.
Agnostus	Of the first and second fauna.
Amphion	Placed with doubt in the first fauna, and is well developed in the second fauna.

The Crustacean fauna of the Quebec Group.

Conocephalus, Arionellus	Genera of the *primordial zone.*
Agnostus	A genus passing from the first to the second fauna.
Dikellocephalus, Menocephalus	Genera of the Potsdam period.
Bathyurus	Quebec Group.
Asaphus	Of the second fauna.
Illænus	Of the second and third fauna.
Amphion	Of the second fauna; and doubtfully of the first fauna in Sweden.
Ceraurus = Cheirurus	Of the second and third Silurian faunæ, and of the Devonian fauna.

We have therefore in the Quebec Group, two established genera of the primordial zone; one, Agnostus, which passes from the primordial to the second fauna: one, Amphion, cited as doubtful in the first fauna in Sweden, and known to be in the second; and three,—Asaphus, Illænus, and Cheirurus, which begin their existence in the second fauna. Of these, Asaphus begins and ends in the second; Illænus begins with the second and continues to the third; while Ceraurus (= Cheirurus) begins in the second, extends through the third Silurian, and appears in the Devonian fauna.

Bathyurus is a new genus, and as yet has no stratigraphical value in comparisons. Those which I described as Olenus have proved to be not true Oleni; and though much resembling that genus, are nevertheless distinct; and I have proposed the names *Barrandia* and *Bathynotus* for the two forms.† These have yet no stratigrahpical

* Not Elliptocephalus of Emmons.

† Thirteenth Annual Report of the Regents of the University of N. Y., on the State Cabinet of Natural History, Albany, December, 1860.

value, except so far as their relations to established genera may aid in that direction.

The genera *Dikellocephalus* and *Menocephalus* are of the Potsdam group; and so far, the Quebec group is in parallelism with the Potsdam and Calciferous strata.

Of the other genera, we know Asaphus, Illænus, and Ceraurus (= Cheirurus) in the Trenton limestone and Hudson River groups; Illænus and Ceraurus. Niagara age, or the third fauna of Barrande; while Ceraurus occurs also in the Devonian of Europe. Amphion is known in the second fauna in Europe, and doubtfully in the first.

Ceraurus does not occur in this country, so far as I know, above the Niagara group; though known in the Devonian rocks of Europe.

The following tabular arrangement of the genera found in the Quebec group will serve to express more distinctly the relations of the Crustacean fauna of these rocks.

The letters at the head of the columns have the same reference as those used in the communicalion of Sir William Logan.

	A	A^1	A^2	A^3	A^4	B^1	B^2	B^3
Arionellus,	....	—	4	....	....	....	....	....
Conocephalus,	....	—	1	....	....	....	....	....
Agnostus,	....	—	3	1	....	....	....	....
Dikellocephalus,	....	—	6	....	....	....	....	....
Menocephalus,	—	1	—	—	—	....	....	....
Bathyurus,	....	—	4	4	1	....	....	1
Barrandia, } *Shales of*	....	....	....	....	....	....	....	....
Bathynotus, } *Georgia, Vermont.*	....	....	....	....	....	....	....	....
Amphion,	....	....	....	2	....	....	....	....
Asaphus,	....	1	....	....	1	....	....	1
Illænus,	....	....	....	....	....	....	....	2
Cheirurus (Ceraurus),	....	....	....	2	....	....	....	....
Leperditia,	....	....	....	....	....	....	1	....
Lingula,	2	—	2	....	....	....	....	....
Discina,	....	—	1	....	....	....	....	....
Orthis,	1	—	1	2	1	11	1	3
Leptæna,	....	—	1	1	....	1	....	....
Strophodonta,	....	—	....	1	....	....	....	....
Camerella,	....	....	1	1	1	....		...
Cyrtodonta?	....	....	....	1	....	....	..	...
Maclurea,	....	....	....	....	....	....	..	1
Murchisonia,	....	....	....	3	....	....	..	1
Pleurotomaria,	....	....	....	7	....	....	..	2
Helicotoma,	....	....	....	2	....	....	..	1
Straparollus,	....	....	....	2	....	....	..	...
Capulus,	....	....	....	2	....	....	..	...
Ophileta,	....	....	....	....	....	....	...	1
Nautilus,	....	....	....	....	....	....	...	1
Orthoceras,	....	....	....	....	....	....	...	3 or 4

	A	A¹	A²	A³	A⁴	B¹	B²	B³
Cyrtoceras,	....	....	....	....	....	....	....	1
Crinoidal columns,	....	....	....	....	....	....	....	....
Tetradium,	1	....	....	....	....	....	....	....
Dictyonema,	3	....	....	1	....	....	....	....
Graptolithus,	25	....	....	....	....	....	....	....
Retiolites,	1	....	....	....	....	....	....	....
Reteograptus	2	....	....	....	....	....	....	....
Phyllograptus,	5	....	....	....	....	....	....	....
Dendrograptus,	3	....	....	....	....	....	....	....
Thamnograptus,	3 [?]	....	....	....	....	....	....	....

In this table we find, of previously recognized trilobites of the primordial fauna, two genera and five species; of previously known genera of the second and third faunæ, *four genera* and eight species; *two genera* before known in the Potsdam sandstone and seven species, and of Agnostus, which is of the first and second faunæ, two species; and one new genus with nine species.

These are certainly very curious results; and a modification of our views is still required to allow four genera and eight species, (or leaving out Amphion) three genera and six species of the Trilobites of the second fauna to be associated with two genera and five species of Trilobites of the primordial fauna, and yet regard the rocks as of primordial origin.

The Brachiopodous genera, Lingula, Discina, Orthis, Leptæna, and Strophomena, have a great vertical range, and are known in the Lower and Upper Silurian, and most of them in the Devonian; while Camerella so far as known is a Lower Silurian form of the second fauna, (perhaps also in a lower position).

Of the Gasteropoda, Maclurea and Ophileta are restricted to Lower Silurian rocks, but occur mainly in the second fauna. The other genera occur likewise in the second fauna and in the Upper Silurian rocks, as well as some of them in Devonian. The same is true of the Cephalopoda enumerated.

Tetradium is known in the second fauna of the lower Silurian rocks, and in the upper part of the Hudson River group at the west. Dictyonema is a genus known from Lower Silurian to Devonian strata.

Graptolithus proper extends to the Clinton group of New York; and the same is true of Reteograptus. Thamnograptus occurs in the rocks of the Hudson River group near Albany, and in the Quebec rocks. Phyllograptus and Retiolites are known in the Quebec rocks

only; while the typical form of Dendrograptus occurs in the Potsdam sandstone, and, likewise, in three other species, in the Quebec rocks.

We find, therefore, in the other genera except trilobites, very little satisfactory evidence on which to rely in the present state of our knowledge, for determining the position of these strata.

In the present discussion, it appears to me necessary to go further, and to inquire in what manner we have obtained our present ideas of a primordial. or of any successive faunæ. I hold that in the study of the fossils themselves there were no means of such determination prior to the knowledge of the stratigraphical relations of the rocks in which the remains are inclosed. There can be no scientific or systematic palæontology without a stratigraphical basis. Wisely then, and independently of theories, or of observations and conclusions elsewhere, geologists in this country had gone on with their investigations of structural geology. The grand system of the Professors W. B. and H. D. Rogers has been wrought out not only for Pennsylvania and Virginia, but for the whole Appalachian chain; and the results were shown in numerous carefully worked sections. In 1843, '44 and '45, I had myself several times crossed from the Hudson River to the Green Mountains, and I found little of importance to conflict with the views expressed by the Professors Rogers in regard to the chain farther south, except in reference to the sandstone of Burlington, and one or two other points, which I then regarded as of minor importance.

Sir William Logan had been working in the investigations of the geology of Canada; and better work in physical geology has never been done in any country.

This then was the condition of American geology, and investigators concurred, with little exception, in the sequence based on physical investigations. As I have before said, our earliest determinations of the successive faunæ depend upon the previous stratigraphical determinations. This, I think, is acknowledged by Mr. Barrande himself, when he presents to us, as a preliminary work, a section across the centre of Bohemia. With all willingness to accept Mr Barrande's determination, fortified and sustained as it is by the exhibition of his magnificent work upon the trilobites of these strata, we had not yet the means of parallelising our own formations with those of Bohemia by the fauna there known. The nearest approach to the type of primordial trilobites was found in those of the Potsdam sandstone of the north-west, described by D. D. Owen; but none of these had

been generically identified with Bohemian forms;* and the prevailing opinion, sanctioned, as I have understood by Mr. Barrande, was that the primordial fauna had not been discovered in this country, until the re-discovery of the Paradoxides Harlani, at Braintree, Mass. The fragmentary fossils published in vol. I., Palæontology of New York, and similar forms of the so-called Taconic System, were justly regarded as insufficient to warrant any conclusions. It then became a question for palæontologists to decide, whether determinations founded on a physical section in a disturbed and difficult region of comparatively small extent, were to be regarded as paramount to determinations founded on a distance in the line of strike of five or six hundred miles; and those of Sir William Logan over nearly as great an extent from Vermont to Gaspé.

It is not possible for me, at this moment, to give the time necessary for a full discussion of this most important subject. In presenting these few facts in this form, I am far from doing it in the spirit of cavilling, or as an expression of distrust in any direction. It is plain that the case is not met in Mr. Barrande's plan of successive Trilobitic faunæ; and the facts yet brought out do not serve to clear up the difficulty. It is evident that there is an important and perplexing question to be determined,—one that demands all the wisdom and sagacity of the most earnest inquirers, and one which calls for the application of all our knowledge in stratigraphical geology and in palæontology;—one in which coöperation, good will and forbearance are required from every one, to harmonize the conflicting facts as they are now presented. The occurrence of so many types of the second fauna in the rocks at Point Levi, associated with a smaller number of established primordial types, offers us the alternative of regarding these strata as of the second stage, with the reappearance of primordial types in that era, or of bringing into the primordial zone several genera heretofore regarded as beginning their existence in the second stage: in either case, so far as now appears, conflicting with the scheme of Mr. Barrande in reference to the successive faunæ of Trilobites as established in Bohemia and in the rest of Europe.

For myself I can say, that no previously expressed opinion nor any "*artificial combinations of stratigraphy previously adopted*" by me, shall prevent me from meeting the question fairly and frankly. I

* The glabellæ of small trilobites undistinguishable from Conocephalus occur in the Potsdam sandstone near Trempaleau, Wisconsin, on the Mississippi river.

have not sought a controversy on this point, but it is quite time that we should all agree that there is something of high interest and importance to be determined in regard to the limitation of the successive faunæ of our older palæozoic rocks.

Albany, N. Y., January 23, 1861.

ON THE PURIFICATION OF THE JUICE OF THE BEET-ROOT, IN THE MANUFACTURE OF BEET-ROOT SUGAR.

BY M. EMILE ROUSSEAU.

Translated, with slight condensation, from the Comptes Rendus, of January 14th, 1861.

Two substances, which oppose themselves more especially to the extraction of the saccharine matter of the beet-root, are always found in the juices of that vegetable. The first of these belongs to the class of albuminous and caseous matters, and undergoes all the modifications produced by reagents on solutions of albumen and caseine. Both lime salts and lime itself effect coagulation, but, with the latter, the saccharine juices remain alkaline after being treated with carbonic acid. This arises from the solution of a portion of the vegetable matter by the lime, and its retention in chemical combination, as shewn lately by M. FREMY; or by the liberation, by means of that reagent, of the potash or soda contained naturally in these juices. The two effects are indeed produced simultaneously, giving rise to an altered condition which is felt more particularly in the final stages of the manufacture.

The other substance, alluded to above, is an uncoloured product, at least whilst contained in the vegetable cell, but, from its avidity for oxygen, it becomes rapidly coloured by exposure to the air, and is otherwise modified by the action of oxidizing agents, so as to become entirely transformed into the well-known brown matter which originates during the evaporation of vegetable juices. In a recent memoir by M. CHATIN, the existence of this substance is confirmed in other ways. When deprived, for example, of all albuminous matter, it reduces

alts of silver, binoxide of mercury, &c. With the latter compound he solution even assumes the natural tint that takes place in sugar fter long exposure to the air.

These facts established, it becomes evident that, in order to simpli-y the production of beet-root sugar, the following reagents must be ought for.

First, a substance of slight solubility, capable of coagulating all lbuminous matters; free from deleterious action on the sugar; mocuous in itself; easily withdrawn from the syrup, in case a small uantity should remain in solution; and finally, of low price.

Secondly, an additional substance possessing a certain oxidizable ower, capable of either destroying at once the coloring matter, or of ransforming this into the brown compound, and afterwards absorbing ; and possessing also the innocuous qualities, absorbing action, nd low price of the preceding substance, together with the capability f being indefinitely reproduced.

Sulphate of lime, either in the natural state or in that of Plaster f Paris, fulfils the first conditions more perfectly than any other ubstance that I have experimented with. It is neutral (a condition hat I regard as essential)—is without action on the sugar, very slightly oluble, innocuous, cheap, and possessed of remarkable coagulating owers with regard to the albuminous matters of vegetable juices enerally, and of those of beet-root in particular. A very small uantity, indeed, is sufficient to produce this effect. The process of urification can thus be carried on to great advantage: the scum is hick and easily collected, and the juice is readily drawn off in a proper tate of limpidity.

This reagent, however, which completely removes all coagulable ubstances, does not touch the colouring matter. The juice conse-uently, after the separation of the scum, quickly assumes a dark tint. nimal-black is almost without action upon this; it only removes the xidized matters, so that the partially-decolorized juice soon regains s former hue. An oxidizing body is therefore required, in order effect at once that which the air produces only after long ex-osure.

Amongst the numerous bodies which I have examined under this oint of view, and which I need not enumerate here, the hydrated esqui-oxide of iron affords the best results. If, for example, after

the removal of all the coagulable matters by the use of sulphate of lime, the saccharine juice be agitated in the cold, or at a temperature under ebullition, with hydrated sesqui-oxide of iron, the liquor passes through the filter entirely decolorized, and purified moreover from almost all traces of foreign substances. In addition to this, the reagent in question, by its well-known property of absorbing alkaline and and earthy salts, removes any small amount of sulphate of lime that may remain in solution. In this manner, the juice, which after the first purification by sulphate of lime, reduces nitrate of silver, binoxide of mercury, &c., becomes without action on these bodies after its treatment with the peroxide of iron.

Under normal conditions the juice thus purified, is perfectly neutral to test-papers; and it may be kept in contact with the air for several days without exhibiting the slightest change or coloration. This is conclusive as to the fact that all matters capable of acting as a ferment, have been removed. It boils easily, and remains uncolored under the action of heat. When brought to the proper consistency, the syrup possesses only the pale yellowish tint of all pure syrups. Its taste is pleasant, and altogether free from that disagreeable saline flavour that is found in ordinary beet-root syrups; and in addition to this, it preserves a remarkable clearness and fluidity. It also crystallizes readily, yielding colorless crystals. Finally, as a conclusive test of the degree of purification obtained by this process, the prepared syrup, brought down to 30° of the areometer by the addition of a proper quantity of water, may be mixed with a large excess of alcohol at 90° without exhibiting any turbidness or yielding the slightest deposit, even after the lapse of several days. Besides which, it does not retain the least trace of iron.

The fabrication of beet-root sugar becomes reduced, consequently, to the following simple processes. The saccharine juice is first to be warmed in a caldron or other convenient vessel with a small quantity (a few thousandths) of sulphate of lime. Common or native gypsum answers best for this purpose. The coagulated matters then collect into a thick scum. Secondly, the clear juice, thus partly purified, is to be agitated with some peroxide of iron. Thirdly, after the separation of this latter, the juice has only to be subjected to the necessary evaporation. The sulphate of lime and the peroxide of iron remove all foreign matters from the sugar, and yield it nothing in return.

The requisite amount of these substances is best learned by experience. The oxide of iron is most conveniently employed in the form of a paste containing from 70 to 80 *per cent.* of water. In no case will more than eight or ten parts of this be required to each one hundred parts of the juice.*

E. J. C.

SCIENTIFIC AND LITERARY NOTES.

GEOLOGY AND MINERALOGY.

NOTES ON THE GEOLOGY OF THE TOWNSHIPS OF WINDHAM AND MIDDLETON, COUNTY OF NORFOLK, C. W.—BY J. DE CEW, PROVINCIAL LAND SURVEYOR.

To the Editor of the Canadian Journal.

SIR,—In a recent tour made through the county of Norfolk for the purpose of collecting fossils and studying the geology of the district, I was much interested with the deposits of the townships of Windham and Middleton; and believing that a communication briefly setting forth the peculiarities of that region might be perused with interest by some of the readers of your valuable *Journal*, I am induced to offer the following remarks:—

The stratified rocks of these townships belong to the Oriskany sand and Corniferous limestone formations. Of the Oriskany sandstone there is but one exposure, occurring in the north-east angle of the township of Windham. This exposure, on account of its hardness, forms a regular escarpment about five feet in thickness, dipping slightly to the south-west, with a strike north-west and south-east, and is traceable throughout a distance of about three-fourths of a mile. This formation is regarded by the Canadian and New York Geologists as the base of the Devonian System, and its composition is too well understood to require notice in this short essay. I might, however, remark, that this exposure is much harder, and contains a larger proportion of feldspar and fewer fossils, than any other I have yet examined.

The fossils met with comprise:—

Favosites Hemispherica...................... Yandell and Shumard.
Zaphrentis prolifica .... Billings.
Orthis. (An imperfect example.)
Strophomena depressa. (Very abundant)....... Linn.
Strophomena ampla.
Pentamerus aratus.
Spirifer —.
Platyostoma ventricosa.

* It may not be out of place to observe that both sulphate of lime and hydrated sesquioxide of iron, (the latter in the form of bog iron ore and yellow ochre) occur abundantly in Western Canada. For special localities, see the present volume of this Journal, pages 151 and 161. Also vol. V., page 175.—*Translator*.

Of the Corniferous limestone I found but one regular outcrop, occurring immediately above the Oriskany sandstone formation, and forming unmistakeably, therefore, the base of the formation. This exposure is about the eighth of a mile in width, and extends north-west into the township of Burford, (where it immediately disappears), and south-east into the township of Townsend. The northern edge of this exposure, consisting of a few thin strata, is no doubt in its proper situation, while the remaining portions have been broken and dragged from their original position by the powerful agencies at work during the drift epoch. This rock consists of a light grey, flinty limestone, weathering almost white, and is far more abundant in corals than in shells. This, it may be observed, is the case with the base of the formation wherever met with, while higher up the shells predominate. The following are the fossils met with in this place:—

Favosites hemispherica	Yandell and Shumard.
——— *turbinata*	Billings.
Michelinea convexa	D'Orbigny.
Heliophyllum Canadense	Billings.
Syringopora tubiporoides	Yandell and Shumard.
Zaphrentis prolifica	Billings.
——— *gigantea*	Lesueur.
Eridophyllum Simcoense	Billings.
Cystiphyllum grandis	Billings.
Strophomena ampla.	
——— *depressa.*	
Atrypa reticularis	Linn.
Platyostoma ventricosa.	
Platyceras ———(?)	

with fragments of *Orthoceras* (one species).

A second and far more extensive exposure occurs in the south-western portion of the same township, and extends south-westerly into the township of Middleton. It is about the fourth of a mile in width, and two miles long, and consists of a dark grey limestone abounding in organic remains. At this place I found no rock which appeared to be in its original position, but huge detached portions lay scattered in great abundance over the surface of the ground, intermixed with the granitic boulders and other detritus of the drift period. Many of these limestone boulders are exceedingly large, and are quarried from the ground for various building purposes. I examined one which contained thirty cords of stone, and was credibly informed that many such had been quarried out where there was no appearance of limestone near them. In some places these boulders cover the ground so thickly as to render it unfit for cultivation. In the township of Middleton, this ridge is cut by Big Creek at Croton Mills. The banks of the creek are at this place about ninety feet high, and exceedingly steep, the valley presenting the appearance of having been worn by the stream passing through it. The bed of the stream is composed of sand, pebbles, and boulders, similar to the surrounding country. At a short distance to the west of the creek the limestone ceases to appear, although the granitic boulders are as abundant as upon the east side.

From this exposure, the following fossils were obtained in the township of Windham:—

Zaphrentis prolifica .... Billings.
Euomphalus (not named; a very beautiful species.)
Orthoceras (one species, not named.)

In the township of Middleton:—

Stenopora (resembles *S. petropolitana.*)
Fistulipora Canadensis .... Billings.
Zaphrentis prolifica .... Billings.
Heliophyllum Canadense..................... Billings.
Michelinea convexa........................... D'Orbigny.
Crinoids (two or three species.)
Orthis (apparently two species; imperfect specimens only were obtained.)
Strophomena (two species, not named.)
Athyris rostrata, or a closely allied species, ... Hall.
Atrypa reticularis (very abundant) .... Linn.
Pentamerus aratus.
Spirifera accuminata (common)................ Conrad.
——— *gregaria* .... Clapp.
——— (not named.)
Lucina Eliptica .... Hall.
——— (one species, not named, found in Windham.)
Conocardium trigonalis...................... Hall.
Platyceras (?)
Loxonema (two species, not named.)
Lituites (?) (one specimen.)
Phacops bufo.
Dalmannites (not named.)

The surface of the area between this exposure and the one in the north-east angle of Windham is covered with fine sand in which boulders rarely occur.

Cayuga, C. W. J. DECEW, P.L.S.

ERUPTIVE SERPENTINES OF TUSCANY.

The origin of Serpentine Rock is still a somewhat debateable point in Geology. Whilst most observers look upon this rock as partly of eruptive and partly of metamorphic origin, according to locality, others, and especially those of the more modern school, appear inclined to consider it in all cases as a metamorphic product. Careful records of its conditions of occurrence, therefore, in different regions, become of general interest and value. In this view, we have embodied in our Geological Notes, the following extract from an interesting memoir communicated by W. P. JERVIS, Esq., F.G.S., to the Geological Society of

London.* Although so different in geological age, the district described by Mr. Jervis appears to have many characters of a more or less general resemblance to those of our Eastern Townships. After describing the products, &c., of four distinct eruptions of Serpentine, Mr. Jervis proceeds as follows:—

"The topographical appearance of the serpentine-eruptions is very characteristic; there is an entire absence of those undulating chains or eminences, melting insensibly into one another, which enable us to classify hills into groups. These rocks form dykes, but more generally constitute whole hills of conical form, rising abruptly to a considerable height, and terminating in rugged, sharp summits. The older rocks have been much upturned and elevated, and are thrown off in every direction,—the serpentine, forming the nucleus of the mountains so abundant along the west coast of Tuscany, Modena, and Piedmont, generally reaching the surface somewhere near the centre, and forming (if I may be permitted the expression) a "periclinal" axis.

The older rocks, nearer the focus of action, are the most disturbed. No feature regarding this serpentine is more important than that of its being almost invariably accompanied by rich ores of copper at its junction with the metamorphosed schists or gabbro rosso. These two rocks, similar in name, are entirely distinct in most other respects: one is an aqueous, the other an igneous rock.

Many minerals are peculiar to the junction of the gabbro rosso and the Miocene serpentine; they are chiefly zeolites. The commonest is caporcianite, a white crystalline mineral, tinged with pink, in structure resembling analcime. These zeolites *all contain magnesia*. They are,—

	Magnesia per cent.		Magnesia per cent.
Savite, containing	13·50	Portite	4·87
Schneiderite	11·03	Sloanite	2·67
Picranalcime	10·25	Humboldtite	2·12
Picrothomsonite...........	6·27	Caporcianite..............	1·11

Miemite (dolomite) contains 42·5 per cent. of magnesia; "gabbro," from La Spezia, 24·4.

Calcareous spar also occurs in limpid and extremely obtuse rhombohedral crystals; it probably owes its origin to the metamorphosis of the limestones. I consider all these minerals to have been produced at the period of the intrusion of the Miocene serpentine, from whence they doubtless derived their magnesia. It is also interesting to find that large quantities of the limestone in the neighbourhood have been altered into dolomites,—the miemite, a delicate greenish rock of the same colour as aquamarine, being a double carbonate of lime and magnesia.

The copper from the serpentine is not associated with galena and blende as with us, but is accompanied by many asbestiform minerals.

The action of the serpentines on the limestones which they have traversed is very varied. Near Matarana I noticed the action on a mouse-coloured limestone, where peroxide of iron had imparted a brick-red tinge to various parts of the

* On certain Rocks of Miocene Age in Tuscany, including Serpentine, Copper Ores, Lignite, and pure Alabaster used in Sculpture. By W. P. Jervis, Esq., F.G.S. *Quarterly Journal of the Geological Society*. (Vol. XVI.) No. 64.

ss. Within a yard or two of the serpentine the rock had been apparently ken into fragments, which had been cemented by delicate veins of serpentine ring into and filling up the cracks. This beautiful metamorphic rock, called fiocalce," is, in fact, calcareous serpentine: it forms a rich combination of ours—deep red and dark green, with interlacing veins of pure-white calcareous r. I would offer this explanation: total decomposition of the limestone was vented by the pressure; the carbonic acid was partially expelled; the heat omposed the carbonate of iron which was present in minute quantities, and apletely peroxidized its protoxide of iron, which, being no longer isomorphous h the pure carbonate of lime, was rejected as the latter crystallized out in ious parts. If I am not mistaken, this would prove that the crystallization of bonate of lime in prisms (as arragonite) only takes place within *limited degrees temperature, above and below which* the crystalline system is the *Hexagonal.*

The copper-mine of Monte Catini is found at the junction of the gabbro rosso l the Miocene serpentine; the ore is invariably in the latter. It is one of the st to be seen anywhere, and [its working] dates at least from the Florentine public. Cosmo I. re-opened it in 1562; but it was not regularly worked, and, m want of experience, little was done until 1837. The indications appear to e been very favourable at the outset; but the successive proprietors failed to lize their desires, until the present company sunk to a depth of 400 feet, owing the indications of ore or "vein" lying E. and W., dipping at an angle 45° S.; they then found an immense mass of copper-ore, from which they racted 330 tons; about 100 feet lower a second deposit has lately been reached, breadth of which I should estimate at 60 feet. The various ores of copper met with in rounded masses, enveloped in serpentine; these nodules constitute pecies of conglomerate,—some of the masses being ore, others boulders of pentine, dispersed through a matrix of steatitic clay. The nodules on being ken open are found to contain chalcopyrites, or bornite,* more rarely oxide of per, grey copper, and native copper. In physical appearance the chalcopy-s differs entirely from that obtained from our mines: thus it is not lamellar or stallized, but hard, compact and massive, and has precisely the same structure bornite, into which it insensibly passes in the same nodules. This pyrites is mixed up with gangue, but perfectly pure, which can be accounted for by the ulsion of impurities, favoured, as it must have been, by the nodular condition the masses. The friction has produced a considerable quantity of fragmentary ites of the size of gravel, which is all washed and employed. I believe I am rect in asserting that iron-pyrites is nowhere found with the serpentine, even ng with the ores of copper. One of the greatest advantages in working these es is the softness of the steatitic rock. Other mines are established at Lib-no, Monte Castelli, &c.: they are newer, and have been hitherto less fortunate. st probably, as Professor Pilla observed, the deposits whence the rich outlying ications proceeded will be met with further down.

Closely associated with the serpentine, chalcedony is found in large quantities

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* Purple Copper Pyrites,=*Erubescite* of Dana, *Phillipsite* of Beüdant and Dufrenoy.—F. C.

north of Monte Verdi; it occurs in regular veins, of considerable size. The mineral is found in blocks smooth at the surface and mammillated internally—often cavernous. I saw some remarkable masses, several feet long, in which small pieces had been cemented together by a fresh development of chalcedony, resulting in a compact siliceous conglomerate without any flaw. The pebbles were principally buff-coloured or green, the cement colourless. The neighbourhood affords specimens showing every gradation between opaque black flint, jasper, agate, chalcedony, and waxy opal."

MINERALOGICAL NOTICES.

American Meteorites:—Professor J. Lawrence Smith has communicated analyses of three new meteorites to the March number of the "American Journal of Science and Arts." 1. *Lincoln County Meteorite:* Ash grey, with white, yellowish, and dark patches, and shining pitch-like crust. Sp. gr. 3·20. Total weight, 8lbs. 14¼oz. Seen to fall, August 5th, 1855. Consists chiefly of pyroxene, with disseminated olivine and orthoclase, and a half-per-cent of nickeliferous iron. 2. *Oldham County Meteorite:* Sp. gr. 7·89. Total weight, 112lbs. Date of fall unknown. Contains: Iron, 91·21; Nickel, 7·81; Cobalt, 0·25; Copper, a trace; Phosphorus, 0·05. 3. *Robertson County Meteorite:* Sp. gr. 7·85. Total weight, 37lbs. Time of fall unknown. Contains. (in addition to nodular granules of iron pyrites, sparingly scattered through its mass): Iron, 89·59; Nickel, 9·12; Cobalt, 0·35; Copper, a trace; Phosphorus, 0·04.

Rutile.—Wolfram.—Cerite: Professor H. Sainte-Claire Deville has detected small quantities of both vanadic and molybdic acid in the Rutile of Saint-Yrieix (Department of the Haute Vienne, France.) Also feeble traces of tantalic acid in the Wolfram of Saint-Leonard; and small amounts of titanic acid and tellurous acid (with traces of vanadium) in the Cerite of Bastnaes, Westmannland, Sweden. "*Sur la présence de quelques éléments ordinairements très-rare dans des substances plus communes.*" *Annales de Chimie et de Physique: Mars*, 1861.

Chrome Garnet:—Professor T. Sterry Hunt, of the Geological Survey of Canada, has kindly sent us the following notice: "A beautiful, emerald-green, transparent garnet is found in Orford, C. E. It occurs massive, granular, and crystallized in calcite, and is associated with Millerite, (sulphuret of nickel.) The finest crystals, which are not, however, above a line in diameter, occur in druses in the massive variety. They are dodecahedrons, sometimes offering replacements on their edges. This garnet resembles the Uwarowite of the Ural Mountains, but differs somewhat in composition, being a lime-alumina garnet containing about six per cent. of oxide of chromium."

Calcite and Arragonite:—Professor Gustav Rose has published in *Poggendorff's Annalen* a series of interesting experiments on the formation of calcite and arragonite, in continuation of his previous researches on that subject. These experiments fully confirm the assertions of Bishof, that arragonite is capable of forming at a low temperature, especially in dilute solutions; and they serve thus, to explain the occurrence of that form of carbonate of lime in the gypsum deposits of certain localities, as well as in the substance of fossil shells, etc.

Professor Rose's investigations shew, also, that although arragonite generally results from crystallization at high temperatures, yet, in concentrated solutions, crystals of calcite, at these temperatures, are equally capable of formation. This fact, as observed by the author, is not without important bearings on some of the natural conditions of occurrence of calc spar. *Ueber die Umstände unter denen der Kohlensaure Kalk sich in seinen heteromorphen Zuständen als Kalkspath Arragonit, und Kreide abscheidet.—Pogg. Ann. Januar*, 1861. E. J. C.

PUBLICATIONS RECEIVED.

Descriptions of New Species of Crinoidea, from Investigations of the Iowa Geological Survey. By James Hall. Albany: February 25, 1861.—The publication of the concluding portions of the Reports of the Geology and Palæontology of Iowa being for a time suspended, Professor Hall has issued these descriptions in order to claim priority for various new species that may probably appear under other names in the forthcoming Report on the Geology of the neighbouring State of Illinois. In addition to numerous crinoids belonging to the genera Actinocrinus, Platycrinus, &c., two new star-fishes are described.

Observations upon the Geology and Palæontology of Burlington, Iowa, and its Vicinity. By Charles A. White.—This is an interesting article reprinted from the *Boston Journal of Natural History.* The rocks described, range from the Chemung beds (Devonian) to the Burlington Limestone of the Carboniferous group; and in addition to classified lists of fossils, notices of seven new species of Devonian Brachiopoda are given.

On certain Theories of the formation of Mountains. By E. Billings, F.G.S.

Notes on the Geology of Murray Bay, Lower St. Lawrence. By J. W. Dawson, LL.D., F.G.S.—The above are valuable reprints from the *Canadian Naturalist and Geologist.* This journal, so ably conducted in itself, and so faithful an expositor of the natural history of the Province, fully deserves the strongest encouragement and support.

On the Amounts of Lead contained in Silver Coins. By C. W. Eliot, and Frank H. Storer.—In this pamphlet, reprinted from the Proceedings of the American Academy of Arts and Sciences, the authors give the results of their examination of various silver coins from American, Spanish, English, and other mints. Small amounts of lead were found in nearly all: the highest (—·3846 per cent.) in some English shillings of 1816. A five-franc piece of Napoleon III. yielded also a comparatively high amount (— ·3546 per cent). In connexion with this subject, the authors discuss the causes of the impurity in question, more especially as regards the United States coinage, and offer various practical remarks of much interest.

Ninth Supplement to Dana's Mineralogy. By Geo. J. Brush, Professor of Mineralogy in Yale College.—In the regretted indisposition of Professor Dana, the preparation of the half-yearly supplement to that author's System of Mineralogy has been again undertaken by Professor Brush. The present supplement contains a list of the principal publications issued since the date of the last or

eighth Report of this series, together with carefully-prepared and judicious analyses of the various memoirs published during this interval in home and foreign journals. We quite agree with Professor Brush in his non-reception, as true species, of the Uranophane of Websky, the Pinitoid of Knop, and other similar products of decomposition. Names thus given, should not be permitted even to obtain an entrance into our already over-burdened list of synonymes.

E. J. C.

CANADIAN INSTITUTE.

Session—1860-61.

SIXTH ORDINARY MEETING—*2nd February*, 1861.

Professor Daniel Wilson, LL.D., President, in the Chair.

I. *The following Gentlemen were elected Members.*

Doctor Charles Jones, Toronto.
W. Saunders, Esq., London, C. W.
G. Arthurs, Esq., Toronto.

II. *The following Donations for the Library were announced, and the thanks of the Institute voted to the donor:*

From W. Hay, Esq., Architect, Toronto.
"British Columbia, &c.," by W. C. Hazlett. One Vol.
"Tales, Sketches and Lyrics," by the Rev. R. J. Macgeorge. One Vol.

III. *The following Papers were read:*

1. By C. Robb, Esq., Civil Engineer:
"On the Petroleum Springs of Canada West."

2. By Prof. T. Sterry Hunt, F.R.S. (Read by Prof. Croft, D.C.L.)
"On the Theory of Types in Chemistry."

SEVENTH ORDINARY MEETING—*9th February*, 1861.

Professor Daniel Wilson, LL.D., President, in the Chair.

I. *The following Gentleman was elected a Member:*

Alexander Lumley, Esq., Toronto.

II. *The following Papers were then read:*

1. By the Rev. Prof. Hatch, M.A.
"On the Gutturals of the Latin Alphabet and their Indo-European Affinities.

2. By Prof. D. Wilson, LL.D.
"Familiar Notes and Illustrations of the Hebridian Islands and their Inhabitants."

EIGHTH ORDINARY MEETING—*16th February*, 1861.

Professor DANIEL WILSON, LL.D., President, in the Chair.

I. *The following Gentleman was elected a Member:*

HUGH R. FLETCHER, Esq., Bruce Mines.

II. *The following Papers were read:*

Prof. G. T. Kingston, M.A.
nnual Meteorological Report for 1860."
Dr. W. Kerr, of Galt, (read by the Secretary.)
n the efficacy of some Canadian Plants in diseases of the Mucous Membrane."

NINTH ORDINARY MEETING—*23rd February*, 1861.

Professor DANIEL WILSON, LL.D., President, in the Chair.

I. *The following Gentleman was elected a Member.*

ELMES HENDERSON, Esq., Trinity College, Toronto.

II. *The following Papers were read.*

T. C. Wallbridge, Esq.
n the mound structures of Southern Ohio, in the vicinity of St. Louis
nati and Newark."

the Rev. Prof. W. Hincks, F.L.S.
n attempt at a new Theory of Human Emotions."

Prof. T. Sterry Hunt, F.R.S. (read by Prof. Croft, D.C.L.)
n the nature of Atmospheric Nitrogen and Ozone."

TENTH ORDINARY MEETING—*2nd March*, 1861.

Professor DANIEL WILSON, LL.D., President, in the chair.

following Donations for the Library were announced, and the thanks of the Institute voted to the Donors.

the Hon. East India Company.
Magnetical and Meteorological observations taken at Bombay, 1858. 1 vol.
C. J. S. Bethune, B.A., Trinity College, Toronto.
Mantell's Pictorial Atlas of Fossil Remains. 1 vol.

II. *The following Gentlemen were elected Members.*

JOHN SCHULTZ, Esq., M.D., Red River Settlement.

JAMES S. MCMURRAY, Esq., Toronto.

III. *The following Papers were read:*

the Rev. Professor E. Hatch, M.A.
abian Metaphysics."

S. Fleming, Esq., C.E.
tes on the Davenport Gravel Drift."

the President, Dr. Daniel Wilson.
e Value of Certain Characteristics of Physical Conformation in which Man
imates to the Lower Animals, with illustrations."

ELEVENTH ORDINARY MEETING—*9th March*, 1861.

I. *The following Donations for the Library and Museum were announced, and the thanks of the Institute voted to the donors:*

For the Library. From the Department of Education, Lower Canada:

1. Journal of Education, Lower Canada, 1860. 1 Vol.
2. Journal de L'Instruction Publique, 1860. 1 Vol.

For the Museum. From Henry Palmer, Esq.:

A New Portable Voltaic Battery.

II. *The following Papers were read:*

1. By Henry Palmer, Esq.:
"Description of a New Portable Voltaic Battery. (Read by P. Freeland, Esq.)
2. By Professor Croft:
"Notes on Canadian Manufactures."

TWELFTH ORDINARY MEETING—*16th March*, 1861.

Prof. DANIEL WILSON, LL.D., President, in the Chair.

I. *The following Gentleman was elected a Member:*

RICHARD HARRISON, Esq., Toronto.

II. *The following Papers were read:*

1. By Dr. C. B. Hall:
"On the Vagaries of Medicine."
2. By Professor Chapman;
(1) "Some Notes on the Drift Deposits of Western Canada, and on the Ancient Extension of the Lake Area of that District."
(2) "Remarks on the genus Orthoceras, in illustration of a remarkably large example recently obtained from the Trenton Limestone of Collingwood, C. W."

THIRTEENTH ORDINARY MEETING—*23rd March*, 1861.

Prof. DANIEL WILSON, LL.D., President, in the Chair.

I. *The following donation to the Library was announced, and the thanks of the Institute voted to the donor:*

From J. Dykes Campbell, Esq.

The North American Review, from 1854 to 1860. (Nos. for July and October, 1860, wanting.)

II. *The following Gentleman was elected a member:*

GEORGE DURAND, Esq., Toronto.

III. *The following papers were read:*

1. By Dr. Woods, Army Medical Staff, Toronto:
"On Sanitary Science in connection with Human Progress."
2 By the Rev. Professor Hincks, F.L.S.:
"Note on the Structure of the Fruit in the Order Asteraceæ or Compositæ."

FOURTEENTH ORDINARY MEETING—*6th April*, 1861.

Professor DANIEL WILSON, LL.D., President, in the Chair.

I. *The following Donations for the Library and Museum were announced, and the thanks of the Institute voted to the Donors.*

For the Library:—

From Dr. G. D. Gibb, London:

1. On Canadian Caverns.

2. From France: Annales des Mines (one number.)

3. From Natural History Society of New York:—Annals, vol. 7, April, May, 1860. Nos. 4–9.

4. From Professor Lawson, Kingston:—On the structure and development of Botrydum granulatum.

For the Museum:—

From Dr. Morris, on behalf of Major Elliott:

1. An Indian Maul, found on the American side of Lake Superior, in 1851.

II. *The following Gentleman was elected a Member.*

CHARLES DURAND, Esq., Toronto.

III. *The following Paper was read:*

By the Rev. Professor Hincks, F.L.S.

"An attempt at an improved Scientific Arrangement of Fruits."

Mr. George Wilson was nominated by the President, and Mr. Samuel Spreull by the Meeting, and these Gentlemen were appointed Auditors for the current year.

At the close of the Session, a very numerously attended Conversazione was held in the Masonic Hall, Toronto, the rooms of the Institute not being sufficiently large to accomodate the number of guests invited on this occasion. The following programme was successfully carried out:

"Canadian Institute,—Conversazione in the Masonic Hall, Friday, April 12th, at 8 P.M. Order of Proceedings:

Communication by the President, Professor Wilson, LL.D.

"Illustrations of assigned Traces of Intercourse between the Old World and the New World, prior to Columbus."

"Oxycalcium Microscope."—P. Freeland, Esq.

"Illustrations of Electrical Phenomena with Rhumkorff's Battery."—Professor Croft, D.C.L.

"First Change of Objects in the Microscopes."—By Drs. Bovell and Richardson, and P. Freeland, Esq.

"Trochilidæ, or Humming Birds."—Prof. Hincks, F.L.S.

"Second Change of Objects in the Microscopes."

"Oxycalcium Microscope: Second Exhibition.

"Third Change of Objects in the Microscopes."

*** In addition to the numerous microscopes exhibited at this meeting, the Council obtained the use of a fine instrument belonging to D. L. Macpherson, Esq., for which a special vote of thanks was awarded.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—FEBRUARY, 1861.

Latitude—43 deg. 39.4 min. North. Longitude—5 h. 17 min. 33 sec. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°. 6 A.M.	2 P.M.	10 P.M.	MEAN.	Temp. of the Air. 6 A.M	2 P.M	10 P.M	ME'N	Excess of mean above Average	Tens. of Vapour. 6 A.M	2 P.M	10 P.M.	M'N	Humidity of Air. 6 A.M	2 P.M	10 P.M	M'N	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Resultant Direction.	Velocity of Wind. 6 A.M	2 P.M	10 P.M	Result.	ME'N	Rain in Inches.	Snow in Inches.
1	29.650	29.532	29.263	29.4623	° 7.8	° 24.8	° 29.8	° 20.50	° — 3.38	.056	.120	.154	.111	.91	.90	.93	.93	Calm.	E	E b N	° N 76 E	0.0	5.8	13.5	7.50	8.09	...	7.0
2	.156	.257	.625	.3722	29.5	30.2	23.0	26.85	+ 3.00	.158	.149	.113	.135	.97	.89	.92	.92	N b W	N W	W N W	N 52 W	3.5	17.5	9.2	11.63	11.86	...	...
3	.902	30.008	—	—	12.9	14.7	—	—	—	.075	.078	—	—	.96	.94	—	—	NW b N	W N W	SW b W	S 85 W	12.2	6.0	6.0	5.30	7.19	...	...
4	.885	29.786	.853	.8367	22.3	30.9	27.0	26.83	+ 3.15	.115	.149	.129	.131	.96	.86	.88	.89	S W	SW b W	W b N	S 59 W	11.5	11.5	1.5	7.24	7.63	...	Inp.
5	.821	.696	.453	.6638	26.2	29.1	25.5	26.67	+ 3.08	.131	.133	.133	.126	.92	.82	.96	.87	W b N	S W	SW b W	S 57 W	2.0	3.0	9.5	7.88	8.19	...	0.1
6	.324	.138	.269	.2400	23.7	32 0	18.7	24.55	+ 1.03	.090	.135	.089	.105	.70	.74	.87	.77	S W b S	SW b W	N W	N 88 W	24.0	20.0	6.4	9.27	16.16	...	2.0
7	28.947	.544	.980	.5288	8.9	—9.8	-17.9	-7.72	—31.15	.056	.027	.015	.030	.86	.96	70	.81	N	N W	N	N 44 W	15.0	35.4	2.0	19.07	19.76	...	8.0
8	30.026	30.125	30.120	30.1002	-15.6	—2.1	—0.8	-5.23	—28.60	.021	.036	.034	.033	.95	.90	81	.90	N N W	W S W	N	N 60 W	4.4	13.0	6.5	3.91	6.39	...	0.5
9	30.100	29.945	29.830	29.9505	7.8	21.5	21.5	18.10	— 5.17	.056	.095	.109	.090	.91	.82	.93	.89	N b E	E b N	N b E	N 70 E	6.8	13.5	2.4	6.96	7.62	...	Inp.
10	29.759	.812	—	—	29.5	42.1	—	—	—	.150	.195	—	—	.92	.72	—	—	Calm.	S S W	N	N 49 E	0.0	0.4	8.5	3.51	3.97	...	...
11	.603	.350	.272	.3950	39.6	43.7	39.9	41.52	+18.25	.227	.265	.241	.250	.94	.94	.98	.95	N E b E	N E b E	N E b E	N 50 E	6.0	5.5	3.8	3.05	4.08	0.300	...
12	.205	.140	.390	.2663	35.6	35.8	31.3	33.70	+10.45	.203	.174	.144	.168	.97	.83	.81	.86	W S W	S S W	W b S	S 57 W	4.5	14.5	27.8	12.49	13.39	...	0.2
13	.579	.776	.859	.7528	31.3	33.8	26.6	30.28	+ 7.03	.160	.158	.134	.145	.90	.80	.93	.86	W N W	W b N	N E b N	N 55 W	7.5	14.5	9.2	9.38	12.37	...	...
14	.898	.694	.467	.6620	26.9	29.8	30.2	28.85	+ 5.58	.131	.109	.157	.131	.89	.66	.93	.82	N E b N	E N E	E N E	N 63 E	9.5	24.5	18.8	19.85	20.06	0.045	1.0
15	.229	.028	.078	.1075	31.6	31.3	32.7	32.05	+ 8.80	.170	.174	.181	.176	.96	.99	.97	.97	E N E	N E	S W b S	S 76 E	15.8	8.5	2.0	1.62	10.34	...	6.0
16	.194	.260	.183	.2135	31.6	33.8	29.8	31.27	+ 7.90	.148	.137	.140	.140	.83	.70	.84	.79	S W	S W	NW b N	S 58 W	16.6	9.5	3.0	6.85	8.22	...	0.3
17	.130	.183	—	—	25.2	31.3	—	—	—	.122	.130	—	—	.90	.73	—	—	W b S	W b S	W S W	S 72 W	11.0	22.5	9.0	10.69	10.78	...	0.1
18	.390	.478	.607	.5048	27.3	29.8	25.5	27.25	+ 3.82	.132	.125	.098	.119	.89	.75	.70	.79	S W	W S W	W	S 76 W	5.5	14.0	12.5	9.65	9.78	...	...
19	.593	.440	.212	.3987	21.2	29.5	31.3	27.50	+ 3.97	.105	.144	.160	.138	.93	.87	.90	.90	W	S E b S	S	S 19 E	1.5	12.0	8.5	7.56	9.32	...	2.0
20	.110	.130	.224	.1625	32.0	34.5	28.8	31.40	+ 7.78	.166	.137	.129	.145	.91	.68	.81	.81	W S W	W b S	W	S 85 W	9.2	14.2	7.2	12.89	13.34	...	0.5
21	.367	.528	.703	.5528	23.7	27.0	22.3	23.87	+ 0.13	.083	.086	.107	.089	.65	.58	.89	.70	W N W	N W b W	W N W	N 60 W	20.0	29.2	21.2	20.06	20.17	...	Inp.
22	.845	.756	.584	.7163	17.2	20.5	24.8	21.02	— 2.80	.081	.086	.120	.097	.85	.79	.90	.85	N N W	E b N	E	N 76 E	4.0	6.5	16.0	10.44	11.13	...	2.0
23	.353	.095	.108	.1757	24.8	30.6	34.5	29.60	+ 5.67	.126	.168	.123	.139	.95	.98	.60	.85	E	E	W b S	S 57 W	18.2	12.6	24.2	3.31	16.43	0.430	Inp.
24	.414	.847	—	—	16.9	15.1	—	—	—	.053	.032	—	—	.56	.35	—	—	N W	N W b W	W b S	N 59 W	31.0	20.0	4.5	13.01	14.57	...	...
25	.925	.728	.573	.7338	19.7	32.7	35.2	29.67	+ 5.33	.090	.113	.175	.128	.84	.59	.85	.76	W S W	S W b S	S W	S 45 W	14.0	21.0	4.5	12.31	12.58	...	...
26	.675	.774	.805	.7613	29.1	40.3	29.5	33.40	+ 8.87	.126	.193	.129	.146	.78	.80	.78	.76	W S W	Calm.	N N W	N 21 W	1.0	0.0	0.5	0.66	1.51	...	...
27	.839	.828	.860	.8467	26.2	41.4	41.4	36.15	+11.43	.124	.171	.187	.166	.87	.64	.72	.78	N N E	SW b W	NW b W	N 77 W	4.0	3.8	11.8	3.76	5.12	...	...
28	.876	.693	.438	.6550	35.3	40.5	34.5	37.32	+12.42	.170	.190	.192	.187	.83	.75	.96	.84	S W	E b N	W N W	N 54 W	2.8	5.2	4.0	3.04	6.18	0.040	...
M	29.5663	29.5300	29.5315	29.5441	23.49	28.82	26.05	26.06	+ 2.39	.122	.136	.133	.130	.88	.80	.86	.84	....	....	....	....	9.34	13.00	9.07	......	10.58	0.815	29.7

Highest Barometer .... 30.144 at midn't., on 8th } Monthly range =
Lowest Barometer .... 28.979 at 7 p.m., on 23rd } 1.165 inches.

Self-regist'ing Thermom.
Maximum Temperature .... 46°0 on p. m. of 28th } Monthly range =
Minimum Temperature ....—20°8 on a. m. of 8th } 66°8
Mean maximum Temperature .... 32°37 } Mean daily range =
Mean minimum Temperature .... 18°54 } 13°83
Greatest daily range .... 32°4 from a. m. to p. m. on 9th.
Least daily range.................. 3°2 from a. m. to p. m. on 18th.

Warmest day......... 11th... Mean temperature......... 41.52 } Difference = 49°24.
Coldest day........... 7th... Mean temperature.........—7°72 }
Maximum { Solar................................ 71°5 on p. m. of 10th } Monthly range =
Radiation. { Terrestrial.........................—28°5 on a. m. of 8th } 100°0.

Aurora observed on 3 nights, viz.: 10th, 27th, and 28th.
Possible to see Aurora on 8 nights; impossible on 20 nights.
Snowing on 17 days; depth 29.7 inches; duration of fall 93.6 hours.
Raining on 4 days,—depth 0.815 inches; duration of fall 21.1 hours.
Mean of cloudiness = 0.83. Above average 0.12.
Most cloudy hour observed, 8 a. m., mean = 0.90; least cloudy hour observed, midnight, mean, = 0.78.

Sums of the components of the Atmospheric Current, expressed in miles.

North.	South.	East.	West.
2056.49	1458.92	1571.40	4093.65

Resultant direction N. 77° W.; Resultant velocity 3.86 miles per hour.
Mean velocity.......................... 10.58 miles per hour.
Maximum velocity .... 39.6 miles, from 2 to 3 p. m. on 7th.
Most windy day ....21st......... Mean velocity, 20.17 miles per hour. } Difference =
Least windy day.........26th......... Mean velocity 1.51 ditto. } 18.66 miles.
Most windy hour ...noon to 1 p.m.............Mean velocity 13.55 ditto. } Difference =
Least windy hour ... 10 to 11 p.m............Mean velocity 8.61 ditto. } 4.94 miles.

2nd. Fog from 6½ to 9 a.m.—7th. Very cold stormy day.—8th. Very cold day.—10th. Fog from 7 to 10 a.m.—11th. Dense fog from 2 p.m. to midnight.—12th. Ground fog at 6 a.m.—16th. Solar halo at 4 p.m.—20th. Perfect lunar corona from 7 p.m. to midnight.—23rd. Dense fog from 4 p.m.—25th. Solar halo at 2 p.m.—26th. Lunar halo at midnight.—28th. Fog from 10 a.m. to noon; solar halo at 4 p.m.

Great Barometric movement. { 7th, 6 a. m. = 28.947 / 8th, midn't. = 30.144 } Ascending range in 42 hours. = 1.197.
Ditto. { 8th, midn't. = 30.144 / 12th, 2 p. m. = 29.140 } Descending range in 86 hours, = 1.004.
Great Thermom. movement. { 6th, p.m = 35.0 / 7th, midn't. — 20.8 } Descending range in 34 hours, = 55.8.

Great Thermom. movement. { 7th, midn't. — 20.8 / 10th, 2 p. m. 43.0 } Ascending range, in 62 hours, = 63.8.

The Resultant Direction and Velocity of the Wind for the month of February, from 1848 to 1861 inclusive, were respectively N. 69 W. and 3.02 miles.

COMPARATIVE TABLE FOR FEBRUARY.

Year.	Temperature.					Rain.		Snow.		Wind.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	No. of days.	Inch's.	No. of days.	Inch's.	Resultant Direction.	Resultant V'y.	Mean Force or Velocity.
	°	°	°	°	°							
1840	28.0	+5.0	49.1	— 8.3	57.4	8	1.475	6	...	...	...	....
1841	22.4	—0.6	43.4	— 0.3	43.7	1	Inap	9	...	...	...	0.61 lbs.
1842	26.9	+3.9	48.7	+ 2.5	46.2	8	3.625	9	...	...	...	1.03
1843	14.5	—8.5	37.5	—10.2	47.7	1	0.475	21	14.4	...	...	1.05
1844	26.0	+3.0	47.1	— 0.4	47.5	4	0.430	7	10.0	...	...	0.43
1845	26.0	+3.0	46.6	— 3.9	50.5	5	Imp.	9	19.0	...	...	0.99
1846	20.4	—2.6	41.4	—16.2	57.6	0	0.000	13	46.0	...	...	0.65
1847	21.5	—1,5	42.2	— 1.0	43.2	2	0.550	13	27.3	...	...	0.69
1848	26.6	+3.6	46.9	— 0.6	47.5	4	0.775	8	10.8	N 65° W	2.53	5.69 mls.
1849	19.5	—3.5	41.1	— 9.2	50.3	2	0.240	13	19.2	N 41° W	1.48	6.58
1850	26.0	+3.0	49.2	+ 1.3	47.9	7	1.235	9	23.1	N 80° W	3.43	7.61
1851	27.6	+4.6	50.2	+ 1.3	48.9	7	2.600	4	2.4	N 64° W	1.99	6.94
1852	23.4	+0.4	41.2	— 3.2	44.4	3	0.650	11	13.0	S 75° W	3.34	6.42
1853	24.1	+1.1	43.4	— 0.6	44.0	4	1.030	15	12.6	N 49° W	2.51	7.30
1854	21.1	—1.9	42.7	— 5.7	48.4	5	1.460	15	18.0	N 7° E	1.73	6.91
1855	15.4	—7.6	37.3	—25.0	62.3	2	1.770	14	21.8	N 40° W	4.34	8.17
1856	15.7	—7.3	35.3	—18.7	54.0	0	0.000	8	9.7	N 81° W	7.70	10.71
1857	28.5	+5.5	51.2	— 5.9	57 1	11	3.050	11	11.7	S 78° W	3.68	9.82
1858	17.0	—6.0	40.9	— 6.6	47.5	1	Inap	16	26.7	N 72° W	3.22	9.12
1859	26.0	+3.0	43.3	+ 3.9	39.4	6	0.455	14	8.3	N 54° W	2.72	8.50
1860	22.8	—0.2	48.1	— 8.4	56.5	7	1.330	13	18.8	N 61° W	3.28	8.73
1861	26.1	+3.1	44.6	—20.4	65.0	4	0.815	17	29.7	N 77° W	3.86	10.58
M	22.98	...	44.15	—6.16	50.32	4.2	1.046	11.6	18.03	....	...	8.08 Ml.
Diff. from	+ 3.08	...	+ 0.45	— 14.24	+ 14.68	— 0.2	— 0.231	+ 5.4	+ 11.67	....	...	+ 2.50

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—MARCH, 1861.

Latitude—43 *deg.* 39.4 *min. North.* *Longitude*—5 *h.* 17 *m.* 33 *s. West.* *Elevation above Lake Ontario,* 108 *feet.*

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resul't. Direction.	Velocity of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10 PM	ME'N		6 A.M	2 P.M.	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A. M.	2 P. M.	10 P. M.		6 A.M.	2 P.M.	10 P.M.	Re-sult'.	ME'N		
					°	°	°	°	°												°							
1	29.542	29.568	29.496	29.5445	41.7	42.6	36.7	39.72	+14.50	.218	.206	.204	.206	.82	.75	.95	.85	W b N	S W	E b N	N 50 W	8.0	1.8	3.0	0.42	2.60	0.007	...
2	.477	.336	.242	.3387	36.0	39.2	36.0	37.42	+12.00	.196	.216	.206	.209	.93	.90	.97	.93	N b W	C am.	N	N 35 W	2.0	0.0	0.5	0.48	1.81	0.080	...
3	.111	.141	—	—	43.2	42.8	—	—	—	.278	.268	—	—	.99	.98	—	—	W	NW b N	SW b W	S 85 W	2.0	11.2	7.0	5.47	6.85	0.170	...
4	.303	.316	.532	.4027	33.1	34.0	23.3	29.35	+ 3.35	.160	.084	.088	.109	.85	.42	.70	.66	SW b S	W b N	W	S 85 W	12.0	34.5	27.5	15.27	17.25	...	2.5
5	.608	.648	.672	.6518	16.5	22.8	21.5	19.55	− 6.65	.082	.060	.109	.080	.90	.50	.93	.76	W	W	S W b W	S 80 W	5.8	21.4	15.5	16.81	17.83	...	0.1
6	.435	.471	.787	.5820	22.3	21.4	6.8	17.47	− 9.03	.100	.061	.045	.068	.83	.46	.75	.68	SW b W	W N W	N N W	N 55 W	15.5	32.2	17.6	21.27	22.62	...	0.2
7	30.060	30.103	30.024	30.0553	−2.6	9.3	16.1	8.20	−18.62	.033	.062	.074	.055	.87	.93	.83	.84	NW b N	W N W	S E b S	S 74 E	8.5	3.5	6.6	1.72	6.64	...	...
8	29.763	29.411	29.331	.4817	24.4	34.7	38.5	33.12	+ 5.88	.103	.145	.182	.149	.78	.73	.78	.77	E S E	E b N	N W	N 44 E	11.5	12.8	10.5	2.45	9.70	0.050	0.2
9	.341	.397	.283	.3128	32.7	38.8	34.2	34.63	+ 7.12	.172	.161	.168	.162	.92	.67	.85	.81	S W	W b S	S W	N 87 W	5.8	7.2	9.6	8.45	9.69	...	0.1
10	.519	.748	—	—	24.8	21.5	—	—	—	.126	.075	—	—	.95	.66	—	—	N N W	NW b N	NW b N	N 33 W	16.0	20.0	14.0	14.30	14.54	...	...
11	.980	.842	.606	.7950	9.3	32.0	31.6	24.90	− 3.33	.056	.143	.148	.116	.84	.79	.83	.81	W N W	S W b S	S W	S 55 W	4.5	14.0	18.0	13.36	14.23	...	Inp.
12	.597	.688	.622	.6388	32.0	28.0	25.5	27.40	− 1.15	.158	.082	.118	.111	.87	.53	.86	.74	W	E b N	E	N 51 E	7.0	10.2	17.5	8.38	11.61	...	1.0
13	.576	.785	.928	.7792	19.0	25.5	19.0	21.35	− 7.62	.091	.090	.091	.091	.89	.65	.89	.80	NW b N	N N W	N	N 10 W	9.2	15.4	10.2	9.24	10.92	...	...
14	.903	.815	.777	.8253	17.2	25.1	18.3	20.38	− 8.93	.081	.094	.080	.088	.85	.69	.81	.79	N E	E b S	W N W	N 45 E	9.0	7.4	5.0	2.96	5.18	...	0.2
15	.773	.688	.546	.6578	16.5	33.4	29.5	26.77	− 2.95	.083	.134	.136	.119	.90	.70	.83	.81	NW b W	S b E	S W	S 11 W	3.5	9.4	2.0	3.37	3.88	...	...
16	.330	.154	414	.3187	25.2	38.3	22.6	28.12	− 1.92	.118	.168	.089	.122	.87	.72	.72	.74	S W b S	S E b E	NW b W	N 56 W	0.5	0.5	33.0	13.30	15.81	...	...
17	.779	.936	—	—	1.0	8.2	—	—	—	.036	.035	—	—	.76	.54	—	—	NW b N	N N W	NW b N	N 30 W	27.0	15.8	9.0	13.65	13.79	...	...
18	30.176	30.130	30.036	30.1087	-4.1	7.1	6.0	3.48	−27.37	.028	.012	.047	.041	.80	.68	.80	.77	N b E	E b N	N N E	N 38 E	6.5	3.4	6.0	6.26	6.70	...	...
19	30.000	29.955	29.926	29.9550	2.1	18.3	15.8	12.77	−18.50	.045	.062	.072	.059	.91	.61	.80	.75	N N E	E N E	N N E	N 49 E	9.0	5.8	2.5	4.87	5.23	...	...
20	29.855	.679	.504	.6617	12.9	25.9	24.1	22.20	− 9.47	.063	.094	.114	.098	.80	.66	.87	.81	N N E	E	E N E	N 67 E	3.5	18.2	10.2	7.96	11.16	...	2.0
21	.515	.585	.713	.6092	20.8	30.2	24.4	25.32	− 6.77	.103	.131	.110	.113	.92	.78	.84	.83	W	N N W	N W	N 34 W	4.8	14.2	6.8	9.47	10.02	...	0.5
22	.780	.742	.688	.7222	23.3	36.7	28.4	30.37	− 2.12	.103	.164	.126	.131	.82	.75	.81	.77	NW b W	S W b S	Calm.	N 61 W	10.0	5.0	0.0	2.11	3.61	...	...
23	.490	.145	.190	.2652	32.7	37.4	33.8	34.47	+ 1.68	.173	.213	.145	.178	.92	.95	.75	.88	E	E	W S W	S 55 W	4.0	6.5	29.5	9.03	13.17	0.210	Inp.
24	.319	.660	—	—	28.4	27.3	—	—	—	.119	.111	—	—	.76	.74	—	—	W S W	W b N	S W b W	N 76 W	25.2	31.5	3.0	14.07	15.55	...	0.1
25	.858	.582	.534	.6382	30.9	37.4	39.6	36.18	+ 2.62	.164	.143	.237	.183	.95	.64	.97	.85	S b E	E N E	N b E	N 81 E	8.0	8.5	0.5	4.22	5.65	0.468	...
26	.386	.278	.254	.2942	39.9	41.0	36.0	38.97	+ 4.98	.241	.237	.206	227	.98	.92	.97	.95	E	N N E	E	N 74 E	6.8	4.0	16.2	6.77	8.56	0.865	...
27	.097	.226	.568	.3135	37.0	41.0	32.7	37.22	+ 2.80	.209	.200	.150	.190	.95	.78	.80	.84	S E b S	S W b W	W	S 82 W	3.2	14.5	21.0	17.25	18.71	...	Inp.
28	.762	.873	.858	.8440	26.3	34.9	33.8	32.02	− 2.70	.123	.139	.166	.140	.86	.68	.85	.77	NW b W	W b S	Calm.	N 77 W	21.0	12.8	0.0	3.24	8.73	...	...
29	.694	.444	—	—	33.4	36.0	—	—	—	.163	.196	—	—	.85	.93	—	—	E	E b N	N E b E	N 47 E	19.0	4.2	5.0	5.62	11.12	0.275	...
30	.286	.744	30.019	.7197	34.2	33.8	28.7	31.63	− 3.87	.160	.136	.130	.138	.81	.70	.83	.78	NW b W	NW b N	Calm.	N 41 W	28.8	23.5	0.0	13.36	13.87	...	0.2
31	30.104	30.160	—	—	28.7	32.4	—	—	–	.123	.138	—	—	.77	.75	—	—	E N E	S E b E	E	S 89 E	2.2	8.5	12.0	10.29	10.45	...	...
M	29.6357	29.6028	29.6220	29.6206	23.17	30.87	26.52	26.92	− 3.46	.123	.131	.130	.127	.87	.70	.84	.80	......	......	......	......	9.67	12.19	10.80	......	10.56	2.125	7.1

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR MARCH, 1861.

Highest Barometer . . . . 30.200 at 8 a. m. on 18th. } Monthly range=
Lowest Barometer . . . . 29.034 at 7 p. m. on 23rd, } 1.166 inches.

Self-registering Ther.
- Maximum temperature . . . . 47°4 on a.m. of 3rd } Monthly range=
- Minimum temperature . . . . —5°2 on a.m. of 18th } 52°6
- Mean maximum temperature . . 33°53 } Mean daily range=12°82.
- Mean minimum temperature . . 20°71 }
- Greatest daily range . . . . . . 33°3 from p.m. of 7th to a. m. of 8th.
- Least daily range . . . . 3.5 from a. m. to p. m. of 30th.

Warmest day . . 1st ... Mean Temperature . . .=39°72 } Difference=36°24.
Coldest day . . . 18th ... Mean Temperature . . .= 3°48 }

Maximum { Solar . . . . 69°5 on p. m of 1st } Monthly range=
Radiation { Terrestrial . . . . . . —11.3 on a. m. of 18th } 80°8.

Aurora observed on 6 nights, viz: 9th, 13th, 14th, 15th, 19th, and 30th; possible to see Aurora on 16 nights; impossible on 15 nights.

Snowing on 14 days: depth, 7.1 inches; duration of fall, 44.5 hours.
Raining on 8 days; depth, 2.125 inches; duration of fall, 55.2 hours.
Mean of cloudiness=0.62, above average .03; most cloudy hour observed 6 a. m., mean =0.66; least cloudy hour observed 2 p. m., mean=0.59.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
2317.49	1584.71	1741.95	4336.56

Resultant direction, N 54° W; Resultant Velocity, 4.33 miles per hour.
Mean velocity 10.56 miles per hour.
Maximum velocity . . . 36.2 miles, from 7 to 8 p.m. on the 6th.
Most windy day . . 6th—Mean velocity 22.62 miles per hour.
Least windy day . . 2nd—Mean velocity, 1.81 do
Most windy hour, 1 to 2 p. m.—Mean velocity, 12.75 miles per hour. } Difference
Least windy hour, 6 to 7 p. m.—Mean velocity, 8.83 do. } 3.92 miles.

1st. Dense Fog from 10 p. m.; mild day.—2nd. Dense Fog all day; mild day.—3rd. Dense Fog, a. m.; emitting an unpleasant odour.—7th. Solar Halo during forenoon, (very distinct).—11th. Solar Halo at 4.30 p. m.—17th. Cold, stormy day.—18th. Very cold day.—19th. Solar Halo, 4.40 p. m.; Lunar Halo, 7.30 to 10 p. m.—20th. Solar Halo, 6 to 8 a. m., (well defined).—22nd. Lunar Halo, 10.15 p. m.—24th Lunar Corona at 7 p. m.—28th. Imperfect Solar Halo at 1 p. m.—29th. Thunderstorm, 4 to 5-30 p. m., (first of season)

Rapid Changes of Temperature.

16th, p. m., = 44.0 registered } Range in 16 hours = 43.8.
17th, a. m., = 0.2 " }
16th, p. m., = 44.0 registered } Range in 44 hours = 49.2.
18th, a. m., = — 5.2 " }

Rapid Changes of Barometer.

16th, 2 p. m., = 29.154 } Ascending Range in 42 hours = 1.046.
18th, 8 a. m., = 30.200 }
18th, 8 a. m., = 30.200 } Descending Range in 131 hours = 1.166.
23rd, 7 p. m., = 29.034 }

The Resultant Direction and Velocity of the Wind for the month of March, from 1848 to 1861 inclusive, were respectively N. 60° W., and 3.63 miles.

COMPARATIVE TABLE FOR MARCH.

YEAR.	TEMPERATURE. Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	RAIN. No. of days.	Inches.	SNOW. No. of days.	Inches.	WIND. Resultant Direction.	Resultant Velocity.	Mean Velocity
1840	33.3	+ 3.2	56.9	8.7	48.2	8	1 640	8	...	...	...	...
1841	27.7	— 2.4	53.5	— 6.9	60.4	5	1.170	7	...	...	...	0.51 lbs
1842	35.8	+ 5.7	68.7	14.9	53.8	4	3.150	8	...	...	...	0.70 "
1843	21.3	— 8.8	38.6	— 2.8	41.4	2	0.625	18	25.7	...	...	1.18 "
1844	31.3	+ 1.2	50.3	9.6	40.7	8	2.470	8	14.0	...	...	0.57 "
1845	35.4	+ 5.3	61.7	9.9	51.8	5	imp.	8	2.8	...	...	0.66 "
1846	33.1	+ 3.0	49.3	7.6	41.7	9	1.965	5	2.3	...	...	0.30 "
1847	26.2	— 3.9	44.3	4.8	39.5	5	0.850	6	4.2	...	...	0.71 "
1848	28.6	— 1.5	58.9	0.9	58.0	5	1.220	6	9.7	N 66 W	2.03	5.80ms.
1849	33.5	+ 3.4	53.4	15.4	38.0	7	1.525	2	2.3	N 3 W	1.48	5.37 "
1850	29.8	— 0.3	46.0	6.0	40.0	2	0.745	7	11.2	N 52 W	2.62	7.62 "
1851	32.4	+ 2.3	58.7	13.1	45.6	3	0.770	9	8.8	N 21 W	1.93	7.65 "
1852	27.7	— 2.4	44.8	— 3.2	48.0	8	3.080	12	19.5	N 8 W	0.71	5.81 "
1853	30.6	+ 0.5	56.3	— 0.1	56.4	6	1.080	8	7.1	N 58 W	2.60	5.96 "
1854	30.7	+ 0.6	52.8	10.4	42.4	9	2.425	3	2.8	N 53 W	3.39	8.03 "
1855	28.5	— 1.6	48.6	— 2.9	51.5	5	1.485	11	18.1	N 88 W	4.76	9.95 "
1856	23.1	— 7.0	39.3	—13.6	52.9	0	0.000	12	16.2	N 71 W	7.68	11.39 "
1857	27.8	— 2.3	56.5	— 3.9	60.4	4	0.335	15	11.3	N 63 W	6.63	10.84 "
1858	28.4	— 1.7	54.1	— 5.5	59.6	10	0.917	6	0.2	N 58 W	5.45	8.56 "
1859	36.3	+ 6.2	53.7	10.4	43.3	15	4.054	8	1.0	N 64 W	1.96	10.39 "
1860	34.5	+ 4.4	66.4	14.2	52.2	5	0.882	11	2.4	N 64 W	7.61	12.41 "
1861	26.9	— 3.2	43.2	— 4.1	47.3	8	2.125	14	7.1	N 54 W	4.33	10.56 "
Mean	30.13	...	52.55	3.77	48.78	6.0	1.548	8.7	8.77	...	...	8.60
Diff. from Av'ge.	—3.21	...	—9.35	—7.87	—1.48	+ 2.0	+ 0.577	+ 5.3	— 1.67	...	...	+ 1.96

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—FEBRUARY, 1861.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M.D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.—F.			Tension of Vapour.			Humidity of Air.			Direction of Wind.			Horizontal Movement in Miles in 24 hours.	Mean of Ozone.	Rain in inches.	Snow in inches.	Weather, &c. A Cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.		t'nths			6 A.M.	2 P.M.	10 P.M.
1	29.512	29.612	29.924	17.1	20.6	20.0	.078	.085	.091	.83	.78	.85	N E b E	N E b E	N E b E	277.46	6.5	...	1.75	Snow.	Sleet.	Cu. Str. 10.
2	482	495	601	19.0	20.1	20.6	087	091	085	84	85	78	N E b E	N N E	S W	110.10	5.5	...	...	Cu. Str. 10.	Do.	Do. 10.
3	30.064	30.184	30.331	7.8	6.0	— 9.5	040	035	022	64	61	78	N b W	W b N	S S W	269.40	4.0	...	...	Do. 6.	Clear.	Clear. Z. lt. br.
4	245	137	170	—11.3	0.0	1.1	014	038	038	58	85	54	E b N	N E	N E	28.50	4.5	...	0.70	Clear.	Cu. Str, 10.	Cu. Str. 9. Rain.
5	29.612	000	29.914	24.2	29.9	23.0	123	136	106	93	84	86	S W	S	S W	13.74	4.5	Inap.	...	Cu. Str. 10.	Do. 10.	Snow.
6	30.157	29.408	463	7.2	30.3	24.6	042	142	094	70	84	73	S S W	W S W	S b W	280.56	4.0	...	1.00	Do. 10.	Do. 10.	Cu. Str. 10.
7	29.420	517	880	— 6.0	— 6.0	—21.8	024	022	011	70	68	64	N E b E	N	N b W	557.10	3.5	...	1.60	Snow.	Heavy Drift.	Loud & heavy
8	30.214	30.307	30.388	—37.1	—14.1	—19.5	001	011	012	09	74	67	W b S	W S W	W S W	444.80	3.0	...	...	Clear.	Clear.	Clear. [drift.
9	585	537	392	—24.0	0.0	— 7.0	009	027	019	60	61	60	W S W	N E b E	N E b E	98.40	3.0	...	...	Do.	C. C. Str. 4.	Cu. St. 10.
10	162	114	094	7.0	27.2	31.9	043	105	152	76	80	89	N E b E	S	E	116.60	3.5	...	...	Sleet.	Sleet.	Slight Rain.
11	170	29.956	29.770	27.2	44.3	40.1	127	240	225	86	82	91	N E b E	E S E	E S E	80.10	5.0	0.121	...	Slight Rain.	Cul. Str. 10.	Cu. Str. 10.
12	29.631	371	448	39.4	43.7	36.2	210	248	190	86	87	88	S S E	S S W	W S W	74.50	5.0	0.640	...	Cu. St. 10.	Do. 10.	Clear. Au. Bor.
13	571	810	30.061	32.9	30.8	21.6	147	142	100	81	80	79	W S W	W S W	W S W	170.80	2.5	...	...	C. C. Str. 8.	Do. 10.	Do.
14	30.088	30.201	174	8.4	33.8	22.4	048	144	095	97	75	80	W	W	N E b E	39.80	3.0	...	...	Clear.	Clear.	Cu. Str. 10.
15	29.914	29.720	29.499	19.6	22.5	19.9	081	084	081	77	71	77	N E b E	N E b E	N E b E	457.70	4.5	...	2.10	Nim. 10.	Snow.	Snow.
16	504	614	654	9.0	29.4	20.4	051	136	085	37	82	78	N E b E	N E b E	N E b E	250.80	4.5	...	1.46	Snow.	Cu. Str. 4.	Light Cirr. 2.
17	125	101	350	27.6	31.8	31.1	141	149	140	91	84	80	N E b E	W b N	S W	196.50	6.0	...	7.26	Do.	Snow.	Cu. Str. 10.
18	502	552	746	21.7	31.2	23.7	090	136	100	78	77	79	W	W	N b W	247.70	4.0	...	...	Cu. Str. 10.	Cu. Str. 10.	C. C. Str. 8.
19	849	850	[illegible]	9.4	34.1	11.8	050	155	051	70	79	76	W S W	S S W	N E b E	43.10	3.0	...	...	Clear.	C. C. Str. 4.	Cirr. 4.
20	584	300	267	14.1	29.8	24.1	063	148	111	80	89	86	N E b E	N E b E	W S W	100.00	3.0	...	6.51	Snow.	Snow.	Cu. Str. 10.
21	342	541	841	26.0	27.4	11.1	111	123	057	81	82	79	W S W	W S W	W b N	245.40	3.0	...	...	C. C. Str. 10.	Cu. St. 6.	C. C. Str. 4.
22	977	965	999	— 1.0	11.0	2.0	028	048	034	68	69	71	W b N	W	W	258.89	2.0	...	...	Cum. 2.	Clear.	Cirr. 2. Lu. ha.
23	30.030	544	495	3.0	8.4	6.0	036	042	043	72	66	75	N E b E	N E b E	N E b E	228.20	5.0	...	5.47	Cu. Str. 10.	Snow.	Snow.
24	29.371	711	30.090	16.1	16.1	6.7	074	074	037	83	83	62	W	W b N	W b N	418.00	3.5	...	...	Clear.	Cum. 4.	Cirr. Str. 2.
25	30.104	30.060	29.954	2.0	32.0	25.2	034	149	117	71	84	87	W N W	S W	S b E	233.30	2.0	...	...	Do.	Clear.	C. C. Str. 10.
26	29.827	29.757	30.061	27.4	35.4	32.5	123	177	156	84	85	85	W S W	W	S W	177.90	3.0	...	...	Do.	Cu. Str. 10.	Cu. Str. 6.

BY CHARLES SMALLWOOD, M. D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.—F.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Horizontal Movement in Miles in 24 hours.	Mean of Ozone. (tenths)	Rain in Inches.	Snow in Inches	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.					6 A.M.	2 P.M.	10 P.M.
1	29.801	29.904	29.905	34.4	48.4	35.0	.169	.260	.162	.84	.78	80	N b E	S W	S W	133.20	3.5	...	...	Cu. Str. 9.	C. C. Str. 6.	C. Str. 9. Au.B.
2	862	804	732	31.4	43.4	36.1	149	193	170	84	71	80	S b W	S b W	N E b E	10.60	4.5	In'p.	...	Do. 10.	C. Str. 10.	Cu. Str. 10.
3	474	247	415	34.5	41.4	39.0	182	228	201	94	87	88	N E b E	W	W S W	46.30	5.5	0.747	...	Rain.	Do. 10.	Clear.
4	30.454	30.371	549	37.4	34.6	29.0	142	169	129	84	84	82	W S W	W S W	W	270.70	3.0	...	...	Clear.	Cu. Str. 2.	Scud. 4.
5	29.816	29.716	824	9.0	30.4	15.2	051	136	070	77	83	82	W	W	W S W	274.00	3.0	...	...	Cu. Str. 10.	Do. 4.	Clear.
6	674	450	716	16.7	21.6	12.8	068	074	081	75	64	71	S W	W	W	299.10	4.5	...	0.96	Snow.	Snow.	Slight Snow.
7	30.190	30.188	30.398	−11.4	3.0	0.0	020	032	030	70	60	64	W b N	W S W	W S W	370.90	2.5	...	...	Clear.	Clear.	Clear.
8	327	120	29.810	− 1.0	26.6	29.8	030	117	136	69	82	83	S E b E	S S E	S S E	180.90	3.5	...	...	Do.	C. C. Str. 8.	C. C. Str. 4.
9	29.650	29.431	320	34.2	35.6	33.1	182	169	168	95	83	89	S S E	W	W	120.70	7.5	0.264	0.77	Rain.	Rain.	Cu. Str. 10.
10	550	727	30.076	29.4	29.1	19.1	136	142	077	84	86	76	W S W	W S W	W S W	272.10	6.0	...	1.40	C. C. Str. 8.	Cu. Ct. Str. 3.	Clear.
11	30.117	30.100	040	− 1.1	30.9	17.7	028	140	072	68	85	75	W	W	S S E	69.20	3.0	...	...	Clear.	Clear.	C. C. Str. 10.
12	29.664	060	147	21.4	27.0	10.4	085	117	050	78	82	80	S S E	W	S E b E	319.80	4.5	...	1.04	Str. 4.	Do.	Clear.
13	939	000	167	10.6	22.6	18.4	054	095	077	78	79	76	S S E	W b S	W S W	232.90	7.5	...	3.07	Snow.	Snow.	C. Str. 8. Au.B.
14	30.273	214	120	− 4.0	21.9	5.5	024	074	032	61	64	60	N W b N	N E b E	N E b E	14.60	3.0	...	...	Clear.	Clear.	Do. 2. do.
15	137	29.958	000	1.0	32.5	16.1	040	137	070	85	74	80	N E b E	S b W	S S W	17.10	2.5	...	...	Do.	Do.	Str. 2. do.
16	29.753	401	29.450	− 1.0	36.7	29.9	031	170	130	70	80	78	N W	S b W	S S E	27.80	2.0	In'p.	...	Do.	Cirr. 0.	Slight Rain.
17	820	30.040	30.220	− 5.0	7.3	− 2.9	022	037	032	68	62	82	W	W	N N W	343.50	2.0	...	...	Do.	Clear.	Clear.
18	30.497	420	500	−16.4	12.9	− 4.2	012	045	024	69	60	65	W	S W	S S W	56.90	2.0	...	...	Do.	Do.	Do.
19	543	330	198	−17.1	15.9	1.6	003	059	026	12	66	56	N E b E	N E b E	N b E	103.60	2.0	...	...	Do.	Do.	Do.
20	277	247	138	− 3.7	31.9	7.0	031	136	037	83	78	64	N E b E	N E b E	N E b E	10.90	1.0	...	...	Do.	Do.	Cirr. 4. L. hal.
21	29.905	29.900	27.914	6.0	20.0	25.0	040	075	101	75	71	76	N E b E	N E b E	N E b E	27.60	4.0	...	1.10	C. Str. 10.	Snow.	C. C. Str. 6.
22	30.026	30.011	30.000	18.6	47.1	27.9	077	273	129	76	85	88	N E b E	S W b W	W S W	35.20	3.0	...	...	Cu. Str. 6.	Clear.	Clear.
23	29.948	29.741	29.542	15.2	48.4	39.0	061	260	201	74	78	86	E S E	E b N	S	70.80	2.5	...	...	Clear.	Cir. Cum. 4.	Cu. Str. 10.
24	460	576	864	31.0	32.3	26.4	058	156	117	85	85	88	S	W S W	N W	372.60	2.0	...	...	C. C. Str. 4.	Cu. Str. 10.	Clear.
25	30.176	30.040	920	14.4	36.9	32.1	161	156	162	74	75	87	W S W	S E b E	E S E	111.20	2.0	...	...	Clear.	C. C. Str. 4.	C. C. Str. 10.
26	29.890	29.746	748	29.4	34.6	33.7	148	162	162	89	83	84	N E b E	N E b E	N E b E	152.80	6.5	0.510	...	Cu. Str. 10.	Rain.	Rain.
27	524	476	518	33.4	38.1	37.8	168	208	193	89	91	86	N E b E	N E b E	S S W	209.50	4.0	0.235	...	Do. 10.	Fog.	Cu. Str. 10.
28	781	950	30.060	20.0	34.2	29.0	081	155	129	77	79	82	W	W	W S W	618.79	3.0	...	...	Do. 4.	Clear.	Clear. Au. Br.
29	30.214	814	29.770	21.1	39.0	33.1	081	158	168	77	68	89	N E b E	N E b E	N E b E	335.20	5.0	...	...	Cirr. 4.	Cu. Cirr. 4.	Sleet.
30	29.198	697	30.134	40.5	38.7	29.3	219	180	136	87	77	83	W S W	W	N W	187.50	3.5	...	...	Rain.	C. C. Str. 6.	Cirr. 4. Au.Br.
31	428	441	599	15.0	32.4	20.4	061	137	081	78	74	77	N E b E	E S E	S b W	72.20	2.0	...	...	Clear.	Do. 6.	Clear.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR FEBRUARY, 1861.

Barometer	Highest, the 9th day	30.585
	Lowest, the 17th day	29.101
	Monthly Mean	29.730
	Monthly Range	1.484
Thermometer	Highest, the 29th day	55°2
	Lowest, the 8th day	—37°1
	Monthly Mean	18°25
	Monthly Range	90°3
Greatest intensity of the Sun's rays		80°1
Lowest point of Terrestrial Radiation		—39°4
Mean of Humidity		.755

Rain fell on 3 days, amounting to 0.761 of an inch; it was raining 17 hours and 25 minutes.
Snow fell on 9 days, amounting to 27.85 inches, it was snowing 73 hours and 45 minutes.
Most prevalent wind, the N. E. by E.
Least prevalent wind, the E.
Most windy day, the 7th day; mean miles per hour, 23.12.
Least windy day, the 27th day; mean miles per hour 0.17.
Aurora Borealis visible on 2 nights.
Lunar Halo visible on 1 night.
Zodiacal Light bright.
Crows first seen on the 27th day.
The Electrical state of the Atmosphere has indicated constant and moderate intensity.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR MARCH.

Barometer	Highest, the 31st day	30.599
	Lowest, the 30th day	29.198
	Monthly Mean	29.878
	Monthly Range	1.401
Thermometer	Highest, the 1st day	48°.4
	Lowest, the 19th day	—17°.1
	Monthly Mean	21°.94
	Monthly Range	65°.5
Greatest Intensity of the Sun's Rays		76°.6
Lowest Point of Terrestrial Radiation		—19°.7
Mean of Humidity		.768

Rain fell on 6 days, amounting to 1.756 of an inch; it was raining 52 hours 35 minutes.
Snow fell on 6 days, amounting to 8.34 inches; it was snowing 40 hours and 15 minutes.
Most prevalent wind, the N. E. by E.
Least prevalent wind, the E. by N.
Most windy day, the 28th; mean miles per hour, 25.77.
Least windy day, the 2nd; mean miles per hour, 0.61.
Aurora Borealis visible on 6 nights.
Lunar Halo visible on 1 night.
Imperfect Solar Halo the 31st day.
Zodiacal Light was bright.
The Electrical state of the Atmosphere has indicated moderate intensity.

Errata.—In the last number of the Journal, page 191, for—"*Supplementary Chapter to Acadian Geology.* By J. W. DAWSON, LL.D., F.R.S., &c.": read, By J. W. DAWSON, LL.D., F.G.S., &c.—In present No., page 248, line 14, for "from 30 to 50"—read, "from 30 to 70 feet."

Postscript.—Since the translated article, "On the Manufacture of Beet-root Sugar," page 292, was struck off, we have received a later Number of the *Comptes Rendus*, in which the use of Sesquioxide of Iron in the purification of Beet-root syrup, is claimed by M. Maumené.—*Comptes Rendus*, 11 *Mars*, 1861.

THE CANADIAN JOURNAL.

NEW SERIES.

No. XXXIV.—JULY, 1861.

ON THE PETROLEUM SPRINGS OF WESTERN CANADA.

BY CHARLES ROBB,

MINING ENGINEER, MONTREAL.

Read before the Canadian Institute, February 2nd, 1861.

The existence of vast reservoirs of mineral oil hidden beneath the rocks in the western part of our Province, and now for the first time being disclosed to the light of day, forms a subject of the deepest scientific interest, and will amply justify an enquiry into its nature and probable origin, on scientific grounds only. But when we consider the additional importance attaching to the question from the commercial value of the material; and since, in the present crisis of the history of Canada, so much study is directed to the development of her natural resources, no further considerations need be urged to secure attention to the subject.

Petroleum, mineral oil, or fluid bitumen, is an inflammable substance, composed of carbon and hydrogen; of a black or deep brown colour, unctuous to the touch, and exhaling a strong and unpleasant odor. It exudes from the earth, or flows into wells in the manner of water springs, and is generally accompanied with an evolution of gas, the pressure of which seems to constitute the force which occasions the flow at the surface. Springs of petroleum and naphtha (an allied sub-

stance), occur in many parts of the world, and are not peculiar to any of the geological formations.

In the Island of Trinidad there is a great deposit of asphalt, forming a lake about three miles in circumference, and of unknown depth. The pitch at the sides is perfectly hard, but towards the middle it becomes softer, until at last it is seen boiling up in a liquid state, emitting a disagreeable odor, which is sensibly felt at ten miles distance. The appearance of ebullition however is probably due, not to heat but to the evolution of gas; and the tar probably floats on water. In the Island of Barbadoes considerable quantities of petroleum are derived from tertiary strata; and in California, this substance has recently been discovered in great abundance. Lake Asphaltites, or the Dead Sea, in Judea, derives its name from the fact of this material abounding around its shores; here the rocks are of secondary or limestone formation. The bitumen employed by the ancient Babylonians, instead of mortar, was chiefly derived from the fountains of Is—the modern Hit—on the river Euphrates. These fountains are considered to be an inexhaustible source of bitumen, which still flows copiously, mingled with intensely saline and sulphureous waters. The rocks of the district are argillaceous limestone, interspersed with beds of coarse gypsum; but the cause which has for several thousand years produced the perennial flow probably lies at a considerable depth below the surface.

Naphtha is found in Persia and Circassia, rising in the form of vapour through marly soils; and in the north of Italy and some parts of France, the substance is found in considerable abundance. But probably the most powerful and copious petroleum springs yet known are those situated on the banks of the Irawaddi, in the Birman Empire, where in one locality there are said to be no less than 520 wells, annually yielding 400,000 hogsheads of the fluid; and which are reported to have been worked for ages without any symptoms of failure. These springs issue from a pale blue clay, saturated with the oil, and resting upon a species of slate, under which is coal containing much iron pyrites. Mr. Oldham, Superintendent of the Geological Survey of India, pronounces the rocks which yield the petroleum of the Irawaddi to be tertiary, and of the eocene period.

The fact of the existence of the petroleum springs in our own neighbourhood is by no means a new discovery. The early French settlers, and the Indians of western Pennsylvania, were aware of their

existence, and made use of their products. Old oil vats and oil wells have been discovered, affording undoubted evidence of human works of great antiquity; and in Enniskillen, the great centre of the oil spring region in Canada, deers' horns, and pieces of timber bearing the marks of the axe, have been dug up from considerable depths below the surface, in what appear to have been old wells.

The fact of such remarkable springs occurring in western Canada could not fail to attract the attention of our Provincial Geologists, and accordingly we find them noticed in the reports of 1850–51 and 1851–52, although in a somewhat cursory manner, leading to the inference that the material was only to be found in very limited amounts. In the first named report we find the following slight notice: "Springs of petroleum, called usually *oil springs*, rise in the river Thames near its right bank in Mosa; the bituminous oil collected on cloths from the surface of which is used in the neighbourhood as a remedy for cuts and cutaneous diseases in horses. Similar springs exist in the township of Enniskillen, where a deposit of mineral pitch or mineral caoutchouc is said to extend over several acres on the seventeenth lot of the second concession." In a subsequent report, Mr. Murray, having visited the spot, thus describes the Enniskillen deposits: "This bed of bitumen, which in some parts has the consistence of mineral caoutchouc, occurs on the sixteenth lot of the second concession of Enniskillen, in the county of Lambton; but its extent does not appear to exceed half an acre, with a thickness of two feet over about twenty feet square, from which it gradually thins towards the edge in all directions. Bituminous oil was observed to rise to the surface of the water in Black Creek, a branch of Bear Creek, in two places on the seventeenth lot of the third concession of Enniskillen; and I was informed that it had been observed at other places farther down the stream."

The foregoing accounts embody the sum of what was publicly known regarding the oil springs in Western Canada previous to the year 1853, at which date they began to attract the attention of adventurers. It was not, however, until the year 1857 that the material was turned to profitable account. In consequence of the very successful introduction of the new coal oils, both for illuminating and lubricating purposes, under the patent of Mr. James Young, of Glasgow, certain gentlemen, foremost among whom was Mr. W. M. Williams of Hamilton, formed themselves into a company and acquired

the lands in Enniskillen, on which the superficial deposits of asphalt occur, for the purpose of using it as a substitute for coal in the manufacture of such oils, it being ascertained to contain 80 per cent. of volatile matters. It was soon discovered, however, on penetrating below the asphalt, that the material could be obtained in large quantities in the fluid state, and consequently much nearer the condition required in the manufacture. Ultimately the whole adventure devolved upon Mr. Williams, to whom alone is due the merit of developing this branch of industry in Canada, as well as of pointing out the road to success in the same direction in the United States. The capital which Mr. Williams and his associates have invested in the works is over $42,000.

At first the distillation was carried on at the wells, but latterly the per centage of loss in refining being so small (about 30 or 35 per cent.), it was deemed expedient to remove the works to Hamilton, and convey the crude oil thither in barrels. The total quantity which has been raised by Mr. Williams is about 200,000 gallons. Mr. Williams has now five wells in more or less successful operation, yielding on an average from 600 to 800 gallons per day; but the amount which the wells are capable of yielding has never been thoroughly tested, as the difficulty attending the transportation from the wells to the railway station—a distance of about sixteen miles—has hitherto restricted the yield. At first the oil flowed into the wells unmixed with water, but latterly, although the supply is undiminished, large quantities of water are associated with it, insomuch as to render it necessary to use steam pumps to drain the wells.

The success which attended Mr. Williams' operations speedily induced other adventurers to enter upon the same field; and similar oil springs having been found to exist in Pennsylvania, our excitable and speculative neighbours rushed with characteristic eagerness into the business; and detachments from the main body soon invaded the more peaceful and primitive regions of Enniskillen—probing and torturing the earth in all directions, and polluting the air and the waters with the stench and scum of the oil. The success which has attended their operations has been in many instances very fair, and in one or two highly favourable; but in the great majority of cases the lottery has turned up blanks, though there is certainly no lack of gas to buoy up the spirits of the adventurers. Mr. Williams seems to have struck the main artery, and indeed the fact of the superficial deposits

on his lands are a sure indication that here the petroleum existed in the greatest abundance, and nearest to the surface.

The material penetrated is a very stiff light-colored clay—in some cases almost pure white—no doubt chiefly derived from the ruins of decomposed rocks similar to those underlying the clay; unequivocal evidence of which is found in the fact that the clay contains numerous fossils identical with those embedded in the rocks, which are found at various depths, alternating with beds of clay, and consist of thin strata, more or less of a shaley nature, plentifully charged with the fossils peculiar to what is called the Hamilton group of the Devonian system of rocks. No rock of a bituminous nature seems as yet to have been struck; although detached masses of bituminous shale, identical with that which crops out at Kettle Point, on Lake Huron, and containing about fourteen per cent. of volatile matter, are frequently met with in forming the wells.

The depths hitherto penetrated vary from 40 to 120 feet; and in this respect little advantage seems to be obtained by commencing operations on the low grounds, as along the flats of the creeks; for at Mr. Williams' wells the depth is only about 40 feet, while at others in the immediate vicinity, on the flats of Black Creek, where the ground is at least 40 feet lower, although the depth penetrated is three times as great, the supply obtained is as yet inconsiderable. The strength of the oil, also, as indicated by the hydrometer, varies to a considerable extent in different wells, even although they may be very near together; and the supply to each well, at least in the southern part of the township, seems to be independent; these facts indicating the deep-seated origin of the oils. Here also the oil seems to be diffused throughout the clay, penetrating through numerous vertical cracks or fissures both in the rocks and clay, evidently in obedience to some force from beneath; no doubt due to the pressure of gas, which invariably issues in great quantities with the oil, giving to the wells the appearance of boiling caldrons of pitch. These gases produce a remarkable effect on the men who work in the wells, greatly resembling that caused by the inhalation of nitrous oxide or laughing gas; and, in order to the continuance of their operations, it is necessary to clear away the gas from time to time by exploding it. It has recently been ascertained that the vapours of naphtha, anilene, and other hydrocarbons produce physiological effects, resembling those of chloroform and other anæsthetic agents.

In other parts of the township, as at Kelly's wells, ten miles north of Mr. Williams', the conditions and mode of occurrence of the oil are quite different. Here it occurs in a bed of gravel and boulders, at a depth of about 47 feet from the surface, associated with such an amount of water as to render the wells exceedingly difficult in working, although the quantity of oil here is evidently very great. Whether these variations in the physical structure of the region have any connection with the origin of the deposits, it is in the present state of our knowledge of the subject, impossible with any degree of confidence to determine. Recently oil has been obtained by drilling into the rock, and in such cases it is said to be of a superior quality to that derived from the clay or superficial deposits.

The advantage which we possess in Canada over our neighbours in Pennsylvania and Ohio is, that the oil-bearing rocks lie much nearer the surface. On the other hand, the most of the oils obtained south of Lake Erie are lighter, and bear a less per centage of loss in manufacture; they are also much more easily deodorized, or rather have comparatively little unpleasant odor even in the crude state. But the chief drawback to the commercial value of the Canadian oil is its thick and tarry consistence; causing it to foam in an uncontrolable manner, in the ordinary retorts used for rectifying earth and coal oils, and to yield too large a proportion of heavy products. In view of these circumstances, it will obviously be expedient to prepare the material for the market in Canada, and with apparatus expressly adapted for the purpose.

I have hitherto purposely confined myself to what may be called a popular account of the oil springs, detailing only such facts as might attract the attention of a cursory observer. I shall now direct attention to what I proposed as the primary object of this inquiry, namely, an attempt to discover the source, and account for the origin of these extraordinary deposits. And here I must premise that whatever theory I might have to advance is only to be received as a guess at the truth. When so much uncertainty and difference of opinion still exist among scientific men with regard to the origin of coal, notwithstanding the amount of ability and learning that have been brought to bear upon the subject, it would be unreasonable to expect that this comparatively unexplored region of research should be opened up all at once.

The first step in our inquiry will naturally be to investigate and

explain the geological structure of the region where the oil springs are found, regarding which no uncertainty exists, and which, apart from the subject of the oils, is peculiarly interesting.

Sir William Logan has pointed out that, if we conceive a line passing from the head of Burlington Bay through London, Zone, Chatham and Amherstburgh—being in fact the centre line or back-bone of the Western Peninsula—such line would form what is called, in geological parlance, the summit of a flat anticlinal arch; that is, the strata bend or dip slightly in an opposite direction on either side of it. In the present case the dip is so small as to be almost inappreciable by instruments; but it is nevertheless certain that the strata which occupy that part of our peninsula now under review pass under the coal measures of Pennsylvania on the one hand, and of Michigan on the other, at a depth varying from 1000 to 2000 feet; which thickness of course represents, or is the measure of the time, geologically speaking, which elapsed between the deposition of the newest of our rocks and the carboniferous era. Consequently it is quite evident that we must not seek for the origin of the petroleum deposits in the coal formation, properly so called.

The outcrops of the various members of the series of rocks immediately overlying the Appalachian and Michigan coal-fields form strips or belts which are rudely concentric with the coal basins themselves. The region now under notice is precisely the tangent point (as it were) where the corresponding strata under each coal-field meet and blend together, giving to the region occupied by the strata in question a form approaching that of the letter X. These rocks are called the Hamilton Shales, and constitute the lowest member of the Devonian or Old Red Sandstone system. Although in this locality of no great thickness—probably not exceeding 60 or 70 feet—the formation is most interesting in a geological point of view, as containing a well-marked and highly characteristic group of fossils, including the earliest known traces of terrestrial vegetation and of fishes. The formation consists of calcareous shales, with thin bands of denser limestone, and occasionally beds of sandy limestone, which are valuable for building purposes. The shaley portions crumble rapidly on exposure, and form a gray or ash-coloured clay; the fossil contents however remaining entire.

At Kettle Point, on Lake Huron, a locality comprised within the geographical boundaries of the Hamilton Group, there is exposed an

interesting section of highly bituminous and argillaceous slates, which also occur in outlying patches throughout the oil-producing region, and have been ascertained to belong to the lowest measures of the Chemung Group, the next higher in the series.* It would appear at first sight most obvious and natural to attribute the origin and source of the petroleum to the subterranean distillation of these shales, which contain an amount of carbonaceous matter, abundantly adequate for its production; but there is most unequivocal evidence to prove that the oil and gas come from a lower source, and are in all probability the cause rather than the result of the bituminous nature of the shales.†

It is a peculiar and unique feature in the Canadian rocks of Silurian and Devonian age, that beds impregnated with bitumen, and evolutions of gaseous and fluid hydrocarbons occur at various points from the base to the summit of the series, although nowhere to such an extent as in the region now under review; and the fact that these oils have been obtained from the Hudson River group of rocks, in which few or no vegetable remains occur, would lead to the inference that the oils and gases may be entirely of animal origin. The upper beds of the Corniferous limestone in Canada, and the entire mass of the Hamilton shales, are characterized by the extraordinary profusion of organic remains, for the most part animal, with which they are charged; and the evidences which they furnish of the mode of their deposition indicate conditions highly favorable to the conversion of the organic matter into substances of a bituminous nature.

The process of bituminization consists of a species of fermentation or combustion, usually thought to be peculiar to vegetable matter, placed in such situations as not only to exclude the external air and secure the presence of moisture, but to prevent the escape of the volatile principles. The ultimate elements, and even to a great extent, the proximate structure of animal and vegetable tissues, are identical; and it is susceptible of demonstration that animal muscle, placed in similar circumstances, may be converted into substances closely resembling the products of vegetable bituminization.

* A full account of this highly interesting section of rocks will be found in the Geological Survey Reports of Progress for 1847–48, and 1853.

† This circumstance affords a strong corroboration of the theory which has been recently propounded before the French Academy by M. Riviere, attributing the origin of bituminous schists and shales in general to impregnation of their argillaceous material with carburetted hydrogen. See Wells' Annual of Scientific Discovery for 1860.

The epoch of the deposition of the rocks in question seems to have been a time when land and water were struggling for the predominance. The vast masses of the Silurian system of rocks had all been deposited in deep water; and the Devonian rocks are just beginning to emerge, forming vast lagoons, floored and surrounded by coral reefs, and densely inhabited by crinoids, brachiopods, and trilobites; though the latter remarkable creatures, so largely developed a little lower down in the scale, are now becoming rare and approaching extinction. Calamites, the earliest known of terrestrial vegetables, appear struggling for existence among the waves and shifting sands; and the first created fishes sport in the shallow waters. The floor of the ocean, together with these low spits and reefs, is sinking by slow and intermittent stages, and the remains of the scanty vegetation are entombed with those of the marine animals. Layer after layer are thus formed, the crust of the earth still subsidiug as each is deposited.

Let us now inquire what would be the probable result of this condition of things, in so far as it affects the present question. The organic matter thus profusely scattered along the shores, and subjected to the influences of air and moisture, would decompose in the ordinary manner; but when, after partial putrefaction, it was covered up by a layer of sand or calcareous mud, and thus removed from the atmospheric influences, the resulting gases would be confined as in a closed retort; and the carbon and hydrogen, being greatly in excess of the oxygen, would enter into such combinations as we find subsisting in the petroleum and the various hydrocarbon gases; and these would remain pent up in crevices or caverns in the rocks until liberated either by natural or artificial means. In some cases, circumstances might be favorable for the production of the gaseous products unaccompanied by the fluid; and it by no means follows, as many imagine, that the development of gas, even in great abundance, would be an indication of the existence of oil in the same reservoir. The remarkable circumstance of the almost invariable association of salt water with petroleum would appear to afford a corroboration of this theory; for whether it be true, as some suppose, that the chloride of sodium exerts some chemical action on the bituminous matter favoring its production, it is at all events certain that the relative dispositions of land and water, which I have attempted to describe, would be highly favorable to the production of sea salt.

Whether this theory be correct in all its details or not, it seems cer-

tain, judging from the similarity of the products in both cases, that the petroleum has been generated by a process analogous to that which takes place in the destructive distillation of wood-coal or peat in close vessels, where, owing to the limited or total absence of oxygen, the combination of hydrogen and carbon in the form of hydrocarbons is effected. Nature appears to have the power of performing, by means of long time and very moderate temperature, processes which the chemist and manufacturer perform rapidly and by the application of great heat.

As bearing directly upon the chemical composition and nature of petroleum and its products, and illustrating the difference between the Canadian and Pennsylvania crude oils, and those derived from the Collingwood shales, I shall conclude by inserting (by the kind permission of the writer), the following letter with which I have been favored by Professor Croft:

UNIVERSITY COLLEGE, Toronto, Nov. 22nd, 1860.

DEAR SIR,

In reply to your letter of the 20th inst., requesting information as to the chemical nature of the Enniskillen, Pennsylvania and Collingwood oils, I am sorry that I cannot supply you with any very accurate details, not having examined these oils with a view to ascertaining their chemical composition, to any very great extent.

The first two being natural products, are of course quite different from the Collingwood shale oil, which does not apparently exist in a free state in the shale, but is obtained by and formed during the destructive distillation of the animal and vegetable substances contained therein. From the rock consisting almost entirely of fossil trilobites, the oil might perhaps be said to be of an animal origin, unless the rocks were subsequently impregnated with vegetable products.

Hence the Collingwood oil will be found to assimilate in its characters to the oil obtained by the slow distillation of coal, and more especially to that from the Boghead Coal; and will undoubtedly be found to contain a number of those curious chemical compounds which have been so ably investigated by Greville Williams, in his researches on the "Products of the Distillation of Boghead Coal." These substances are of a basic character and rank with the volatile vegetable alkaloids, having the general formula, $C^n H^m N$.

The petroleums or rock oils are essentially different, having been produced by a slow process continued through countless ages, and thus substances of a different chemical nature have been produced, although, perhaps, the material acted on has been nearly, if not quite, the same.

I am not aware of any means by which we can distinguish the products gene-

rated in the great laboratory of nature from animal substances, from those produced from bodies of a vegetable origin. Reasoning from analogy I should imagine it to be impossible, for recent researches have shown great similarity, in many cases identity, between the artificial products from animal and vegetable substances. See Anderson " On the bases from Dippel's Oil "—Williams, quoted above, &c. &c.

Besides the basic bodies above alluded to, these coal oils generally contain a number of hydrocarbons belonging to various series—*e.g.* Benzole, C^{12} H^{6} and its homologues.—Toluole C^{14} H^{8}.—Xylole, Cumole, &c., and solid hydrocarbons, such as Naphthaline C^{20} H^{8}, Paraffine, &c. &c.

The petroleums seem to be composed of hydrocarbons of a different class, having the formula C^{n} H^{n},—such as C^{12} H^{12}—C^{14} H^{14}—C^{16} H^{16} &c. &c., which are quite indifferent bodies, unacted on by nitric acid. Another substance exists in them which has been called Petrole C^{16} H^{10}, and is acted on by nitric acid, and causes the brown or black colour when the petroleums is treated with nitric acid (and probably sulphuric ?). It has been said that Benzole exists in the light oils, but I know not on what authority.

When the Enniskillen oil is distilled it requires a high temperature to drive over much oil, and this oil, when re-distilled, does not pass over readily till between 200° and 210° Centigrade—the product, again distilled, goes over at 190°—200°, and by repeated fractional distillations, I have no doubt from the above experiments, we might obtain an oil boiling at a somewhat lower temperature.

When the Pennsylvania oil is distilled, it begins to pass over at about 130°, and a large proportion is distilled below 190°. When this product is re-distilled, a large proportion passes over below 150°.

Hence the Pennsylvania oil contains a much larger proportion of light volatile oils than the Enniskillen oil. None of them, however, are probably of the formula C^{12} H^{12} which boils at 70°; probably they belong to the higher part of the C^{n} H^{n} series; but in both cases (E. and P. oil) they are pure hydrocarbons, containing no oxygen, at least not in such a form as to act on potassium and sodium. The metals remain quite unaltered and with metallic lustre. Possibly there may be hydrocarbons of the formula $C^{n\,5}$ $H^{n\,4}$ present.

I am not aware that I have any further information to give you at present. The peculiar greenish colour is owing to fluorescence; if the Enniskillen oil be distilled very far, and the thick residue dissolved in hot alcohol, the solution is most powerfully fluorescent, but the dissolved substance is deposited as the solution cools. I am not aware that this fact has been observed. The Collingwood oil contains a very large percentage of heavy oil, paraffine, &c.; the light oil boils at 150°–190°.

Yours truly,

CHARLES ROBB, Esq., C.E. HENRY CROFT.

ON THE MOVEMENTS OF THE DIATOMACEÆ.

BY PATRICK FREELAND, ESQ.

Read before the Canadian Institute, January 19th, 1861.

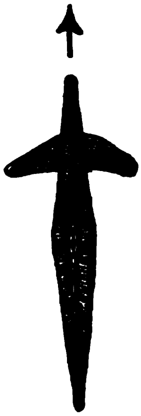
The producing cause of the movements of most of the free species of the Diatomaceæ has never yet been satisfactorily ascertained, notwithstanding the amount of attention bestowed upon the subject. Many eminent observers, with Ehrenberg at their head, maintain that the motion is owing to the action of cilia. "In some species of the Naviculeæ," he says, "it is produced by a flat snail-like foot protruded from each end of the valve." Others, again, maintain that it is owing to forces operating within the frustule, and connected with the endosmotic and exosmotic action of the cell—the fluids which are concerned in these actions entering and being emitted through minute foramina at the extremities of the valves. Dr. Smith, who maintains the movement to be of merely a mechanical nature, produced by a force not depending upon any act of volition in the living organisms, in his Synopsis of the British Diatomaceæ, says, "it appears certain that these motions do *not* arise from any external organs of motion. The more accurate instruments now in the hands of the observer have enabled him confidently to affirm that all statements resting upon the revelations of imperfect object-glasses, which have assigned motile cilia or feet to the Diatomaceous frustule, have been founded upon illusion or mistake. Among the hundreds of species (Dr. S. continues) which I have examined, in every stage of growth and phase of movement, aided by glasses which have never been surpassed for clearness and definition, I have never been able to detect any semblance of a motile organ; nor have I, by colouring the fluid with carmine or indigo been able to detect by the particles surrounding the diatom, those rotatory movements which indicate in the various species of true infusorial animalcules the presence of cilia."

In a paper on this subject, read before the London Microscopical Society, in 1855, by Mr. Hogg, he says, "I have repeatedly satisfied myself that their motive power is derived from cilia arranged around openings at either end—some around central openings, which, with those cilia at the ends, act as paddles or propellers."

Several facts which came under my own observation last summer while observing the motions of the *Pinnularia nobilis*, one of the largest of our fresh-water diatoms, have convinced me that Professor Smith is mistaken in the cause he assigns for these movements. If he is correct in his supposition that they are owing to the imbibing and ejection of fluid alternately at either end of the valve, then their motion must invariably be the. same, never varying, advancing and retreating motion; but this is not so, I have repeatedly seen a diatom, when met by an obstacle in its path, suddenly change its course by a quick lateral motion, and go off in a direction quite different to that it was formerly pursuing, and frequently have I seen this done when there was nothing apparently to cause it, but as if from mere caprice the course had been changed.

On one occasion, I was fortunate enough to get a large, beautiful Pinularia in the centre of the field of view, and just beside it was a small piece of decayed vegetable matter. As the diatom moved along, this substance, instead of remaining stationary, or being carried along with the frustule in its forward motion, as would be the case were Professor Smith's theory correct, was propelled in the opposite direction, in a manner precisely similar to what it would have been, had it stood beside a ciliated infusorial Animalcule instead of a diatom. Its motion, however, was not regnlar, at least not as regular as that of the diatom, but somewhat intermittent, as if the repelling force to which it was subject was stronger in some places than at others, which fact seems to confirm the idea entertained by Mr. Hogg, that the cilia are not placed all along the valve, but at intervals. When this substance reached the end of the diatom, the rapidity of its motion increased, as if the force applied to it had suddenly become greater, or was more directly applied, and at a short distance from the valve, all its motion ceased. On the return journey of the diatom, the same process was repeated, the small body beginning to move before it came into contact with the diatom, and continuing its course as before, only in the contrary direction.

On another occasion, while a frustule of the *Pinnularia acuta* was traversing the field of view, it came in contact with a valve of Cocconema, lying directly across its path. Striking it fair in the centre, it passed partly over the obstruction for about one-third of its own length, as represented in the diagram, and then stopped as if it had got stuck between the diatom it was thus attempting to pass over,



and the thin glass cover of the live box. After a very short period of rest, the Pinnularia gave one or two short jerking motions, and then the Cocconema began to move rapidly, broadside on, in a direction opposite to that pursued by the former (which remained stationary) until it passed partly beyond it, when the Pinnularia resumed its journey; this was done twice in precisely the same manner; on the third journey, it had changed its course, and passed beyond the obstructing valve. The arrow indicates the direction in which the Pinnularia was moving. The Cocconema was of course forced in the opposite direction. Now, a result very similar to these might be produced by the expulsion of a fluid from the Diatom valve, according to Professor Smith's theory, but the orifices through which it would require to be forced would have to be placed along the side of the valve as well as at either end. And not only would this be necessary, but two sets of orifices, pointed in opposite directions, would be essential, in order to produce the double motion, backwards and forwards. While two sets more would be required to produce the motion I have before described, when the diatom saw fit to change its course. And besides all this elaborate mechanism, another must still be added, by means of which every opening would be completely closed but those for the moment employed in producing the motion in one given direction.

If this really is the correct solution of the question, the motion then of the Diatomaceæ is unique, for I doubt if any thing analagous to it can be found in nature. But if the presence of cilia be granted them, then there is no difficulty in at once understanding how every movement of the diatom valve can be readily produced merely by changing the direction of the ciliary motion. The objection urged by Professor Smith, that by colouring the water, no motion in the particles of the colouring matter could by him be detected, if it is a valid one against ciliary action, it is equally fatal to his own theory, for in his way of accounting for the motion, a current *must* be produced, but he has never seen any, or been able to detect it, and from this, he concludes there are no cilia. Let us reverse Professor Smith's argument, and the case will stand thus:—

If the motion is caused by the expulsion of a fluid from the

frustule at each end alternately, then that must cause a current in the water, at the point where the fluid is forced out, and if there is a current, it will become visible if the water be coloured with carmine or indigo. But even with the best glasses, unsurpassed for clearness and definition, and with the water containing the diatoms, coloured in the usual way, no current is visible; therefore no current exists, and therefore the motion is not produced by the endosmotic and exosmotic action of the cell, and the consequent emission of a fluid through minute foramina at the extremities of the valve.

I must, however, admit that with objectives constructed by our best London makers, and after careful observation, I have hitherto failed to detect either cilia on the diatom, or a current in the water; but the facts I have now submitted, seem to me to be wholly irreconcileable with Professor Smith's theory, and to lead to the conclusion that these movements are owing to the presence of cilia arranged along the exterior of the diatom valve. It must be borne in mind that the very small specific gravity of the diatom valve would require an extremely slight power to produce all the motion we see, and that consequently the cilia, if the motion is so produced, may be so extremely delicate as hitherto to have evaded actual detection, but that fact is not sufficient to warrant the conclusion that because cilia have not been actually seen, therefore, they do not exist."

NOTE ON LAND AND FRESH WATER SHELLS COLLECTED IN THE ENVIRONS OF TORONTO, C. W.

BY A. E. WILLIAMSON.

(*Read before the Canadian Institute, Saturday, Jan. 19th,* 1861.)

I propose, in the following short paper, to give the result of the researches of an amateur in one branch of a favourite pursuit, made in a somewhat desultory manner and in the intervals of business, during which I have managed to collect a tolerably well filled cabinet.

Among the specimens thus collected, those of the fresh water and terrestrial shells comprise a small but very interesting portion;

restricted, however, to the species existing in my own immediate neighbourhood, and a few collected at Paris, C. W.

I intend here to confine myself to the shells found in the vicinity of Toronto, viz. at Weston, Toronto Island, and Todmorden on the River Don.

I must not omit the expression of grateful acknowledgment to the Rev. Professor Hincks, for his valuable aid in their determination.

The shells consists of representatives of the two classes, GASTEROPODA and CONCHIFERA.

In the class GASTEROPODA, we find examples of the genera *Helix*, *Planorbis*, *Succinea*, *Limnæa*, *Paludina*, *Valvata*, *Melania* and *Physa*, as shown in the following list of species.

Genus HELIX,—1. *H. albolabris* (or white-lipped Helix). 2. *H. alternata*, these two varieties are very common. 3. *H. monodon*; 4. *H. tridentata*; 5. *H. ligera*. I found this latter variety at Todmorden. Prof. Hincks was unaware of its being Canadian: his specimens are from Ohio.

Genus PLANORBIS,—1. *P. trivolvis*; 2. *P. bicarinatus*; 3. *P. campanulatus*; all very common.

Genus SUCCINEA,—*S. vermeta?* (Say.)—I have found this shell only at Weston.

Genus LIMNÆA,—1. *L. stagnalis*; is very common on the Island, the only locality at which I have observed it*. 2. *L. palustris*=*L. elodes* (Say), common on the Island.

Genus PALUDINA,—1. *P. impura*; 2. *P. porata* (Say); this variety is known now by the name of *Amnicola porata*. All the small shells heretofore known as Paludinas are now referred to the genus Amnicola: both these shells are found on the Island.

Genus VALVATA.—1. *V. tricarinata*; 2. *V. piscinalis*.

Genus MELANIA. *Melania*.—Very common, *Amnicola (paludina) porata*, classed with this genus under the sub-genus *Amnicola*: not very common.

Genus PHYSA,—1. *P. heterostropha* (Say); this variety closely resembles *P. fontinalis* of Europe: very common on the Island. 2. *P. ancillaria* (Say) also very common.

A few more species, one of which resembles *vertigo pygmæa* of Europe, can be obtained at the above mentioned localities.

* Since writing this, Dr. Bovell informs me that he has found *L. stagnalis* in the River Humber.

In the class CONCHIFERA, we have representatives of the genera *Unio*, *Anodon*, and *Cyclas*.

Genus UNIO,—1. *U. nasutus;* very common on the Island. 2. *U. ochraceus:* 3. *U. complanatus*, also from the Island. A few more species or varieties can be obtained at the Island and Weston. Considerable difficulty is encountered in the naming of Unios, from the immense number of species, and the want of proper works of reference.

Genus ANODON:—Several varieties of this genus are to be found —principally at the Island.

Genus CYCLAS:—This genus is very common. The specimens obtained probably comprise several species, but their characters are too minute and inconspicuous to admit of any definite determination.

ON THE DEVONIAN FOSSILS OF CANADA WEST.

BY E. BILLINGS, F.G.S.

(Continued from Vol. VI. *page* 282.—No. XXVIII. *May*, 1860.)

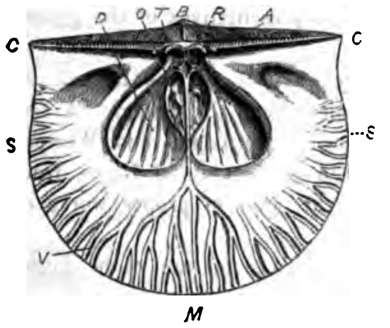
Genus STROPHOMENA.—(Rafinesque.)

STROPHOMENA.—(Rafinesque.) De Blainville. *Manuel de Malacologie*, p. 513, Pl. 53, fig. 2, 2a, 1825. Davidson. *Introduction to the Classification of the Brachiopoda.* p. 106.

LEPTÆNA.—Dalman, *and many other authors.*

LEPTÆNA. + STROPHOMENA + STROPHODONTA, *either wholly or in part, of Hall and American authors.*

Generic characters.—Shell, semicircular, semioval, sub-quadrate or sub-triangular, with the hinge line straight; one valve convex and the other concave; in a few species both valves nearly flat. Both valves provided with an area, that of the ventral valve usually the larger. Area of ventral valve with a triangular or linear foramen or fissure in the middle beneath the beak, either wholly or partially closed by a deltidium; in some species no foramen. Area of dorsal valve often with a triangular projection in the middle, caused by the protrusion of the bases of the divaricator processes; in some species



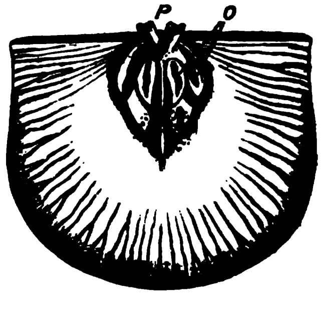


Fig. 103. Fig. 104.

Fig. 103.—*Strophomena inæquistriata.*—Conrad. Interior of ventral valve; S.S.,—the sides; M.—the front margin; C.C.—the cardinal angles; the edge of the area from C to C is the hinge line; A.—the flat space terminating the shell on the straight side is the area; B.—the beak; the small linear ridge beneath the beak is the deltidium; T.—teeth; R,—the rostral septum; D.—the divaricator muscular scar or impression; O.—the occlusor; V.—the vascular impressions. This figure is drawn as if the shell were flat in order to show all the parts more clearly.

Fig. 104.—*Strophomena demissa.*—Conrad. Interior of dorsal valve. P.—the two divaricator processes or levers for opening the valves; O.—the occlusor muscular impressions or scars.

this is absent. Valves articulated together at the hinge line or inner edge of the area, by teeth in the ventral valve, and sockets in the dorsal, the structure of which varies in different species. Surface ornamented with fine or coarse radiating striæ or small ribs; in a few species smooth.

On the inner surface of the ventral valve there are two large pyriform or subtriangular muscular scars or impressions, situated one on each side of the median line and in the upper half of the valve. These are the impressions of the DIVARICATOR MUSCLES or those whose function it was to open the valves. Between them there are two much smaller scars situated also, one on each side of the median line. These are the impressions of the OCCLUSOR MUSCLES, or those whose function it was to close the valves. On comparison it will be seen that the arrangement of the scars in the ventral valve is in a general way the same as in *Athyris* and *Spirigera.* It is nearly the same in *Orthis, Chonetes, Producta, Atrypa, Spirifera,* and in most other genera of Brachiopoda.

In some species, but not in all, the cavity within the beak and umbo of the ventral valve is divided into two compartments, by a vertical

ridge or septum. This I propose to call the ROSTRAL SEPTUM. It varies greatly in size, and is often absent altogether. It cannot therefore be regarded as an organ of generic importance.

In the interior of the dorsal valve there are four small scars arranged in two pairs, one pair on each side of the median line. These are the OCCLUSORS corresponding to those of the ventral valve. In this valve the divaricators were attached to two small processes situated close to the hinge-line. (See fig. 104, P.) These are notched at their extremities, and grooved on the outside, or side next the area. These I propose to call the DIVARICATOR PROCESSES; their function was to open or divaricate the valves; the mechanical principal upon which they operated was simply that of the lever. This will be more clearly understood by consulting Fig. 105.

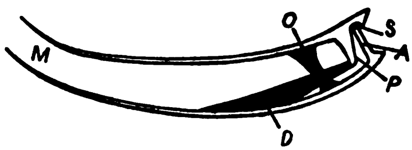


Fig. 105.

Fig. 105.—A longitudinal section through both valves of a *Strophomena* from the beak to the front margin; the dorsal valve uppermost. M.—the front margin; A.—the area of the ventral valve; S.—the socket in the dorsal valve for the reception of the teeth of the ventral valve; P.—the Divaricator Process (or lever); D.—the Divaricator Muscle; O.—the Occlusor. It is evident that by the contraction of the Divaricator muscle the extremity of the process P must be drawn towards the point D, and thus the dorsal valve must turn on the hinge at S, (as a door turns on its hinges.) By this movement of course the valves were separated at the front margin M. By the contraction of the Occlusor O, the valves were drawn together. It appears that in most of the *Palæozoic* genera of Brachiopoda the muscular apparatus consisted of these two sets of muscles, but a little modified in different groups.

In *Strophomena* the form of the scars and their distinctness varies to some extent in different species, but their arrangement is in a general way the same in all.

In addition to the muscular scars, the inner surface of many species exhibits numerous radiating branching channels, usually most distinct near the margin. These are the impressions of the vessels of the vascular system.

We shall now notice more particularly some of the variations exhibited by the parts above mentioned in connection with the following proposed genus.

Genus STROPHODONTA.—(Hall.)

In 1847, Mr. Sharpe pointed out that in *Strophomena demissa* there was no foramen, and says: "It will probably be found to indicate a distinct genus, as it must be accompanied with a peculiar internal arrangement. Until this can be ascertained this species may remain in *Leptæna,* the genus to which it is most closely related."*

In 1849, Professor Hall proposed his genus *Strophodonta* (giving *S. demissa* as the type) founding it on the characters pointed out by Sharpe, and adding thereto the following remarks on the interior: "In the interior there are no dental lamellæ margining or surrounding the muscular impressions, which are spread out over a considerable surface in the dorsal valve, shewing partially a double or bilateral arrangement. In the ventral valve there is some indication of a limitation, or marginal elevation, to the muscular impression, but the character is quite distinct from the same in *Leptæna.*"†

In 1852, Prof. Hall redescribed the genus, founding it upon the striated area and closed foramen, but gave no internal characters, except, "Muscular impression somewhat bilateral."‡

In 1858, Professor Hall, in the Geology of Iowa published the following more detailed description of the internal characters:

"In the ventral valve the teeth are much reduced or nearly obsolete, a central more or less prominent bilobed process usually occupying the centre of the area in place of the triangular fissure of STROPHOMENA. Muscular impressions strongly marked, semielliptical or subreniform, separated in the middle by a depressed line, and sometimes margined by a semicircular ridge, which is an extension of the lamellæ from either side. Vascular impressions foliate or flabellate, extending beyond the areas towards the base of the shell.

"Dorsal valve with the muscular and vascular impressions strongly marked: cardinal process bifurcate from the base, with each branch bilobed at the extremity, *by which it is articulated to processes beneath the area of the opposite valve,* receiving between its forks the cardinal process of the opposite or ventral valve, which is bilobed or grooved for the passage of the peduncle. Entire interior surface papillose."§

I hold that the above is simply a description of the internal characters of the genus *Strophomena* with the exception of the passage that I have put in italics, which contains a statement decidedly incorrect. We have a number of specimens of *S. demissa, S. inæquistri-*

* SHARPE, in *Quar. Jour. Geol. Society.* Vol. 6, p. 172.

† HALL. In Proc. Am. Ass. 1850, p. 348.

‡ Pal. N. Y. Vol. 2, p. 63.

§ HALL. Geology of Iowa. Vol, I., Part 2, p. 491.

ata and *S. ampla,* showing clearly the inside of the area of the ventral valve, and there are no such processes as those mentioned by Prof. Hall. It is also evident that if the Divaricator processes were as he says—articulated to processes beneath the area of the ventral valve—the shell could not be opened at all. The notch and groove in the Divaricator levers are simply the scars or marks of the attachment of the muscle.

The divaricator processes *i. e.* the ("*cardinal process bifurcate from the base*") occur in all species of *Strophomena*, and are not peculiar to those which he has placed in his genus *Strophodonta.* They vary a good deal in their form in different species. The most ancient species in which I have seen them is *S. filitexta.* The following Fig. 106 represents their form in this species, and it will be seen that they differ only specifically from those of *S. demissa.*

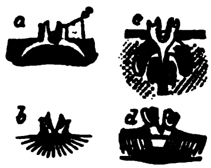


Fig. 106. Fig. 107.

Fig. 106. *S. filitexta.* *a* Divaricator processes, front view. *b* Viewed from the outside, shewing the groove. The specimen is from the Black River Limestone. *s.* The dental sockets.

Fig. 107. *S. demissa.* Copied from Geology of Iowa, Pl. 3, fig. 5. *c*—Divaricator processes, front view. *d*—The same viewed from the outside.

The specimen of *S. filitexta,* from which the above fig. 106 was drawn, does not show the occlusor muscular scars, and in fact the interior of the dorsal valve is rarely so preserved as to shew them. In *S. rhomboidalis* and *S. Philomela,* the divaricator processes consist of two short ridges, abruptly terminated on the side of the area, their extremities not elevated above the surface of the shell, and if the length of the processes were of generic importance, then these two species would belong to a genus distinct from *S. filitexta* and *S. demissa.*

As to the muscular impressions, the following figures will show that, although they are subject to considerable modifications of form, their arrangement does not vary.

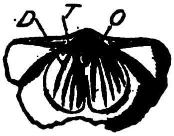


Fig. 108.

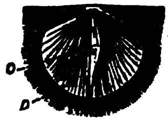


Fig. 109.

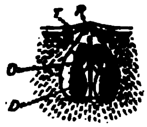


Fig. 110.

Fig. 108.—Represents the muscular scars in a specimen of a species closely allied to, if not identical with *S. alternata*. It is from the Black River Limestone, Pallidean Islands Lake Huron. The scars are deep, and well defined. O.—the occlusors. D.—the divaricators. T.—the teeth.

Fig. 109.—*S. alternata*. Hudson River group. The scars not well defined.

Fig. 110.—*S. Philomela*. Middle Silurian. The scars well defined. R.—the rostral septum, rudimentary. O.—occlusors. D.—Divaricators.

When these are compared with Fig. 103, it will be seen that, although there is some difference in form, the arrangement of the muscular apparatus is the same, *i. e.*, the divaricators outside, and the occlusors between them.

The same rule holds good with respect to the occlusors. In all the species (in which they have been observed) they are arranged in two pairs, one pair on each side the median line, and yet they differ in form according to the species. Even in different individuals in the same species they differ. Thus Fig. 107 differs from 104. Both of the figures differ from that given by Davidson in the *Geologist*, Vol. 2., pl. 4, fig. 15, which was drawn from a specimen procured from Prof. Hall, and all of them differ from a specimen in my possession—from the Hamilton Shales of New York.

With respect to the foramen, the specimens in our collection, and the figures given by various authors, show that there has been a gradual change in the size of the orifice.

1.—Silurian. Most of the species with the foramen large, its width greater than the height. Ex.—*S. alternata*, *S. filitexta*, *S. planoconvexa*, &c.

2—Devonian. Most of the species with the foramen very narrow, sometimes reduced to a mere line across the area of the ventral valve, and in some entirely absent. Ex.—*S. inæquistriata*, *S. ampla*, *S. demissa*.

In comparing the fine series in our collection (embracing species from every formation, from rocks holding Primordial Trilobites up to the Corniferous), and also the figures given by Barrande, De Verneuil, Davidson, Hall, and others, it is clear that in the size of the foramen

there is every shade of gradation from an aperture two lines wide down to nothing. I hold, therefore, that the size of the foramen is too variable to be of value as a generic character.

The same gradation occurs also in the extent to which the hinge line is crenulated.

1.—Lower Silurian.—Most of the species with the hinge-line and teeth smooth.

2.—Middle and Upper Silurian.—Most of the species with the teeth or a small portion of the hinge-line next the foramen striated. Ex. *S. Leda. S. Philomela. S. euglypha, &c.*

3.—Devonian.—Most of the species with a large portion or nearly the whole of the hinge-line striated.

The striation of the area appears to have kept pace with the diminution of the foramen; the one gradually increasing from the Silurian upwards to the Devonian and the other as gradually diminishing.

The striated hinge-line and area is not peculiar to *Strophomena. Leptæna transversalis* and *Chonetes hemispherica* exhibit the same character, although most other species of these two genera do not.

For the above reasons and also because there is no difference in the form of the shell, I hold that the genus *Strophodonta* is quite superfluous.

Number of species of Strophomena.

On examining the various Reports of the Geological Surveys of the neighbouring States, I find that SEVENTY-THREE species have been named as occurring in the Upper Silurian and Devonian Formations of these countries. According to my view, this number must be greatly reduced. I do not think there can be more than twelve or fifteen. In Canada West I can only recognize nine species in the Oriskany Sandstone, Corniferous Limestone and Hamilton group, and three of these, *S. magnifica, S. magniventra* and *S. Pattersoni,* may be only varieties, the first two of *S. perplana* and the last of *S. inæquistriata.*

STROPHOMENA RHOMBOIDALIS.—(Wahlenburg).

LEPTÆNA DEPRESSA + STROPHOMENA DEPRESSA + LEPTÆNA RUGOSA + STROPHOMENA RUGOSA + LEPTÆNA TENUISTRIATA? + PRODUCTA DEPRESSA + P. ANALOGA, &c. Either wholly or in part, of the generality of authors.*

Fig. 111.

Fig. 112.

Fig. 111.—*Strophomena rhomboidalis*, with the front straight.
Fig. 112.—The same with rounded front.

Description.—Rhomboidal or irregularly semi-oval, widest on the hinge-line, occasionally somewhat square: visceral disc strongly corrugated by from nine to fifteen deep undulating concentric wrinkles; both valves abruptly bent at one-half or two-thirds the length to form a broad margin deflected towards the dorsal side. In the ventral or convex valve the disc is nearly flat, but with a small portion in front of the beak gently tumid. The curvature of the dorsal valve conforms very nearly to that of the ventral. Area of ventral valve narrow, seldom exceeding half a line in width; the dorsal area still narrower; the two areas inclined towards each other at an angle which varies from 30° to 60°. Foramen of ventral valve large, triangular, wider than high, partly filled by the two projecting extremities of the divaricator processes of the dorsal valve. Surface covered with fine crowded striæ of a nearly equal size throughout, five or six in the width of one line.

In the interior of the ventral valve the muscular impressions occupy a subcircular cavity which is about one-third the length of the valve and is bordered by an angular slightly elevated margin. The divari-

* Prof. Hall is desirous of having this species called *S. rugosa*, and says that he has seen specimens of it labelled under that name in Rafinesque's hand-writing. But according to the laws of scientific nomenclature, manuscript names cannot be recognized at all. The first published specific name is (*rhomboidalis*), and this must be retained. The figure of *S. rugosa*, published by De Blainville as the type of the genus, in 1825, in the *Manuel de Malacologie*, certainly does not represent this species.

cators are situated one on each side, and the occlusors (seldom well defined) between them. The form of these scars appears to be at first sight somewhat different from that of *S. inæquistriata* but on a little examination it will be seen that the general arrangement is the same and the form only specifically different. On each side of the foramen is a single short tooth.

In the interior of the dorsal valve the divaricator processes consist of two short elevated ridges terminating abruptly just over the area, their extremities not elevated, and free as they are in *S. demissa.* They are separated in some specimens (but not in all) by a deep oval pit. On each side is seen a small oblique socket or pit for the reception of the tooth of the opposite valve. Just in front of the divaricator ridges are the two small scars of the occlusor muscles, each scar divided into two by an oblique ridge not often well developed, but distinctly seen in a beautiful specimen now before me. These scars are small, each pair occupying a space only one line in length and breadth in a specimen one inch wide. The two pairs of scars are separated by a low mesial ridge, which in some specimens becomes a thin elevated septum towards the front of the shell. The vascular impressions are only well marked round the margin.

Width from one-inch to one-inch and a-half; length about one-third less than the width.

Specimens two inches wide sometimes occur.

Affinities.—This wonderful species has no near relatives in the Devonian rocks. By the form and structure of its foramen, divaricator processes and muscular impressions, it is clearly a Lower Silurian type belonging to the group, which includes *S. alternata,* and its varieties *S. deltoidea* and *S. tenuistriata* (Pal., N. Y., Vol. 1). It commenced its existence just at the close of the Lower Silurian period, or perhaps a little earlier, and lived on, with scarcely any change through the immeasurable ages of the Middle and Upper Silurian and Devonian, and even until the Carboniferous was well advanced.

Locality and formation.—Occurs at nearly all the localities of the Oriskany Sandstone, Corniferous Limestone and Hamilton group in Canada West. Also in all the older formations down to the top of the Hudson River group.

Collectors.—A. Murray, E. Billings, J. De Cew, E. De Cew, Judge Wells, Chatham, Wm. Saunders, London.

STROPHOMENA INŒQUISTRIATA.—(Conrad.)

STROPHOMENA INŒQUISTRIATA —Conrad. *Journal of the Academy of Natural Sciences of Philadelphia.* Vol. 8, p 254. Pl. 14, fig. 2, 1839. Also compare the descriptions and figures in the same work of S. CREBRISTRIATA; S VARISTRIATA; S. RECTILATERIS and S. IMPRESSA.—Conrad. Also, S. VARISTRIATA; and S. VARISTRIATA, *var.* ARATA.—Hall. *Pal. N. Y.* Vol. 3, p. 180, 184. Also the following in the 10th Ann. Rep. Regents N. Y. Univ., S. INŒQUIRADIATA; S. TEXETILIS and S. CONCAVA. —Hall.

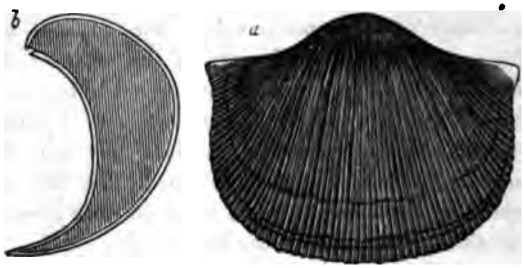


Fig. 113.

Fig. 113.—*Strophomena inæquistriata.*—Ventral view of one of the forms of this species *b.*, longitudinal section.

Description.—Semi-circular, semi-oval, or sub-triangular, width on hinge-line varying from one to three inches; length from two-thirds to seven-eighths of the width; cardinal angles compressed, forming rounded or acute ears which are more or less extended. Ventral valve varying greatly in the amount and in the form of its convexity; usually with the visceral disc depressed convex and the margin all round abruptly curved down for one-third or one-half the whole length of the shell; sometimes the shell uniformly arched from beak to front; the umbo often so greatly developed as to overhang the hinge-line and bring the area under the body of the shell; in other specimens the convexity of the umbo is continued along the middle to the front, producing a broad mesial carination; in many the front is greatly produced in a gradual slope from the anterior margin of the disc, and occasionally we find specimens with the front margin so much curved as to be to some extent inrolled under the shell; in all the umbo is more or less prominent, there being a somewhat flat or depressed sub-concave space of greater or less extent on each side

extending to the cardinal angles. The dorsal valve is usually not so much curved as the ventral, thus leaving a comparatively large space for the animal.

Area of ventral valve from one-fourth of a line to one line in width, flat or concave, obliquely striated all except about one-tenth the length at each extremity, a wide shallow notch on the edge, in the middle of which is the foramen. Dorsal area about half-a-line wide and not so variable in its dimensions as is the ventral.

Fig. 114.

Fig. 114.—A fragment of the ventral area natural size, shewing the foramen and the wide notch in the edge of the area.

Foramen small, linear, closed, usually about one-fourth of a line wide, sometimes less. Teeth rudimentary, and situated one on each side of the foramen on the edge of the area. Cavity of the beak divided into two compartments by a rather strong rostral septum.

In the interior of the ventral valve the divaricator scars are large, sub-pyriform, and one-third the length of the whole shell. The occlusors are ovate, half the length of divacirators, often with the surface covered with minute corrugated wrinkles like the scars of some species of *Producta*. The vascular impressions are well marked on some of the casts of the interior, but vary in the number of the branches, usually from three to five in the width of one line at the margin. In thin shelled individuals they are not seen at all. Interior of dorsal valve not observed.

Surface very variously striated. In some the striæ alternate in size, there being one set of fine sharply elevated lines distant from half a line to one line from each other, the intervening spaces flat and with from three to seven finer striæ just visible to the naked eye; in others the intervening spaces are concave. In many the principal striæ become coarser and closer together until the whole surface is covered with strong angular bifurcating ridges from one-fourth of a line to half a line in width. In very well preserved specimens of these latter, the coarse ridges are seen to be themselves ornamented with the fine longitudinal striæ. In all cases the whole surface when perfectly preserved, is beautifully cancellated by minute crowded concentric striæ.

Affinities of this species.—This species belongs to a type which

appeared in the lower Silurian seas, and is found more or less abundantly in every formation from the Chazy up to the Chemung group. Many of the Devonian specimens so exactly resemble some of the varieties of *S. alternata*, the dominant species of the Trenton and Hudson River group, that were it not for the striated area and nearly obsolete foramen, they could not be separated therefrom. The general form, striation of the surface, and some of the internal markings are so nearly the same, that one can scarcely help thinking that those we find in the Devonian rocks are the lineal descendants of those with which the lower Silurian strata are crowded. Professor Hall's description of *S. varistriata* of the Lower Helderberg rocks, of New York, applies exactly to this species (See Pal. N. Y., Vol. 3, p. 180–184) the only difference being that the specimens are in general smaller. I think that on comparison of good series of specimens that species may yet be united to this, or perhaps all those above cited may be united under one name *S. varistriata*. Should only the Devonian varieties be united I think they should all be referred to *S. inæquistriata*, as that form has been more extensively described and illustrated by Conrad and Hall than any of the others.

Locality and formation.—Oriskany Sandstone ; Corniferous Limestone; and Hamilton Group at nearly all the localities of these rocks in Canada West.

Collectors.—A. Murray ; J. Richardson ; J. De Cew ; E. De Cew; Wm. Saunders, London, and Judge Wells, Chatham.

STROPHOMENA PATERSONI ?—(Hall.)

STROPHOMENA PATERSONIA.—Hall. Tenth Annual Report of the Regents of the University of New York.

Fig. 115.

Fig. 115. *Strophomena Patersoni* Ventral view.

This species has all the characters of *S. inæquistriata*, the only difference being that the surface is marked by numerous concentric wrinkles. I retain the name for the present provisionally, but have strong doubts as to its claims to rank as a distinct species. The shells are always thin, with two sets of radiating striæ, the stronger ones distant from one-fourth of a line to one line, and with from three to twelve very fine ones between.

Locality and formation.—Oriskany Sandstone, and Corniferous limestone. County of Haldimand.

Collectors.—J. De Cew ; E. De Cew.

STROPHOMENA DEMISSA.—(Conrad.)

STROPHOMENA DEMISSA.—Conrad. *Journal of the Academy of Natural Sciences of Philadelphia.* Vol. 8, p. 258, pl. 14, fig. 14, 1839. STROPHOMENA or STROPHODONTA DEMISSA.—Hall, in various works. Compare also S. SUBDEMISSA.—Hall. Tenth Ann. Rep. Regents, N. Y. Univ. p. 145, and S. ARCUATA.—Hall. Geology of Iowa. Vol. 1. Part 2, p. 492, Plate 3, fig. 1, *a, b, c, d,* 2. *a, b, c.*

Fig. 116.

Fig. 117.

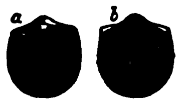


Fig. 118.

Fig. 116.—One of the forms of *S. demissa*, ventral view.
Fig. 117.—The same specimen, dorsal view.
Fig. 118.—Two views of a very small specimen.

Description.—Semioval, subquadrate or subtriangular; hinge line equal to, greater or less than the width of the shell; cardinal angles often forming extended or short acute ears; in some specimens the sides and front margin are uniformly curved, giving the semioval form represented above, (fig. 116) ; in others the sides are somewhat straight and parallel for two-thirds of the length, and the front margin broadly rounded, approaching the subquadrate aspect; others are rounded subtriangular, the hinge line being extended and the front narrowed, while some have the greatest width in the front half. The width varies from a little less to one-third greater than the length.

The most common size is from one inch to one inch and a half in width, but very small specimens of from four to twelve lines are often found.

The ventral valve is in general rather strongly convex, uniformly arched from beak to front, sometimes a little flattened in the central region; the umbo small, rounded but prominent, overhanging the area, the shell on each side depressed or subconcave towards the cardinal angles; in some a broad obscure carination extends from the umbo along the middle to the front, with an obscure longitudinal depression on each side

Dorsal valve moderately concave, usually with a shallow mesial sinus commencing in a point at the beak and growing wider towards the front.

Area of ventral valve in some specimens broad and somewhat flat: usually narrow; often concave beneath and on each side of the beak, either striated the whole length, or with a very small portion at the cardinal angles smooth. Dorsal area not so variable as the ventral; the two areas inclined to each other at an angle which varies from less to greater than a right angle, according to the degree of curvature of the beak of the ventral valve.

No foramen; a smooth triangular space beneath the beak on the area of the ventral valve.

Surface with from ten to fifteen coarse angular ridges on the umbo of the ventral valve which bifurcate several times, and become smaller towards the front margin. In some small specimens the ribs do not bifurcate.

In the interior of the ventral valve the muscular scars are of the same type as those of *S. inæquistriata*, but the occlusors are proportionally nearer the beak. In the dorsal valve the occlusors are situated in the upper one fourth of the length of the shell; they are divided by a median ridge which sometimes is much elevated about the middle of the shell. There are usually two or three large tubercles or short curved ridges just in front of the impressions. In thick shelled specimens, the scars, median ridge and tubercles form a group occupying an oval space which extends nearly half the length, and is narrowed to a point below. In some there is a large space around the muscular area covered with small tubercles; in others this space is smooth. The vascular inpressions are only well marked near the margin.

Affinities and varieties.—This species stands nearer to *S. inæquistirata* than to any other. It differs from that species in the absence of a foramen, in the area being striated the whole length, in being more uniformly convex, and in the characters of the surface. There is little variation in the aspect, although the general contour differs somewhat. The ventral area varies from half a line to two lines wide, being almost linear in some specimens, and in others so wide as to give a low triangular form. In general the specimens from the corniferous limestone are smaller than those of the Hamilton group. I have seen none from the former rock more than one inch and a quarter wide; but many from the last mentioned formation with a breadth of one inch and a half.

Locality and Formation.—In most of the localities of the corniferous Limestone in Canada West. As yet, we have found none in the Hamilton group in Canada. My comparisons have been made altogether with specimens from the Hamilton shales of New York.

Collectors.—E. De Cew, J. De Cew, E. Billings.

STROPHOMENA PERPLANA.—(Conrad).

STROPHOMENA PERPLANA and S. PLURISTRIATA.—(Conrad). *Journal of the Academy of Natural Sciences of Philadelphia.* Vol. 8., p. 257–259. Pl. 14, fig. 11.

S. CRENRISTRIA and S. FRAGILIS.—(Hall). *Tenth Annual Report of the Regents of the University of the State of New York.* P. 111–143.

Description.—Nearly flat; covered with fine, equal radiating striæ. Width on hinge line from one to two inches; length varying from a little more to one-fourth less than the width. In form, the shell is usually semioval—the front regularly rounded; sometimes the sides are suddenly constricted just beneath the cardinal angles; often the sides are nearly straight and parallel for half the length, then uniformly rounded to the fronts; some have the front rather straight, giving a subquadrate aspect. The ventral valve is slightly convex, most elevated at about one-fourth or one-third from the beak, flattened towards the hinge line, often with a few obscure irregular concentric wrinkles. Dorsal valve gently concave. Area of ventral valve about one line wide at the beak, slightly concave. Area of dorsal valve about half the width of the ventral—the two areas inclined towards each other at an angle of about 90°. Both areas striated. No foramen.

Surface covered with fine equal striæ; from six to nine in the

width of one line; these are crossed by fine concentric striæ eight to twelve in one line. The radiating striæ increase both by subdivision and intercalation of new ones between the old; they are often irregularly undulated, and the surface of the shell has thus a somewhat minutely uneven surface. In some specimens, however, this character is not apparent.

In the interior of the ventral valve the muscular impressions occupy a large sub-triangular depression in the substance of the shell. This is about a line wide at the hinge line, from which point the sides of the depressed space are nearly straight, and diverge outwards at an angle of about 45° to the median line of the shell. The depression gradually disappears, so that it is difficult to define its front margin. Still, in very well preserved specimens, it can be seen that the divaricators are of an elongate oval shape, and that they extend more than half the length of the shell; the occlusors are elongate oval, and situated close to the hinge line, their length one-third of that of the divaricators. These latter are sometimes divided into several lobes by thin, slightly elevated, longitudinal ridges. On each side of the muscular cavity, near the hinge, the shell is covered with small tubercles.

This species is so easily recognized by its flat form and evenly striated surface that a figure of it is unnecessary.

Although it has received a separate name for every formation in which it occurs, yet I cannot make out the slightest difference between the specimens of the Oriskany Corniferous and Hamilton rocks. I think, also, that S. *magnifica* of Hall is only a large variety of this species.

Locality and Formation.—Oriskany Sandstone, Corniferous Limestone, in County of Haldimand. Hamilton Shales, Township of Bosanquet.

Collectors.—E. De Cew, J. De Cew, E. Billings.

STROPHOMENA LEPIDA.—(Hall).

STROPHODONTA LEPIDA.—(Hall). *Geology of Iowa.* Vol. I., part 2, p. 493. Pl. 3, figs. 3*a*, 3*b*, 3*c*. 1858.

Compare S. NACREA.—(Hall). *Tenth Annual Report of the Regents of the New York University*, p. 144. Also, S. LEPIS.—(Bronn). *Lethæa geognostica*, 3rd edition. Vol. I., p. 367. Atlas. Pl. 2, figs. 7, a, b, c.

Description.—Shell small, smooth or scaly, no radiating striæ, about three-fourths of an inch wide, half an inch long, sub-semicir-

cular, or sub-quadrate, usually rounded in front, cardinal angles either rounded or auriculate. Ventral valve rather uniformly convex, cardinal angles compressed, rarely preserved, but when they are, a little reflected. Dorsal valve concave. Area of ventral valve half a line wide, lying in the plane of the lateral margin; when perfect, longitudinally striated, or nearly smooth; when a little worn, shewing obscure vertical striæ; edge of the area serrated. Area of dorsal valve half the width of the ventral, with a row of small tubercles on the outer edge, and a corresponding row of small pits on the inside. No foramen.

Internal surface of dorsal valve covered with small tubercles, usually about half a line apart; occlusor scars (in a specimen nine lines wide) situated one line from the hinge, each scar longitudinally divided by three elongated tubercles; one line below each scar there is a prominent oval tubercle; half way between these are two others on the median line. The divaricator processes are two short stout projections, with their extremities notched, and the upper side grooved. I have not seen the interior of the ventral valve.

This species is probably only a variety of *S. lepis*, Bronn, of the Devonian rocks of Europe. It is easily recognized by its surface, which is destitute of radiating striæ.

Locality and Formation.—Corniferous Limestone, County of Haldimand. Township of Bosanquet, in the Hamilton Shales.

Collectors.—E. De Cew, J. De Cew, J. Richardson.

STROPHOMENA AMPLA.—(Hall.)

STROPHOMENA AMPLA.—Hall. *Tenth Annual Report of the Regents of the University of the State of New York*, p. 112, 1857.

Compare S. PUNCTULIFERA.—Conrad, S. HEADLEYANA.—Hall, S. CAVUMBONA.—Hall, S. LEAVENWORTHANA.—Hall, and S. GENICULATA.—Hall, all in the 3rd Vol. of the Palæontology of New York.

Description.—Shell, large; from two to three inches wide on the hinge line; length from two-thirds to four-fifths the width; ventral valve concave, with a gentle convexity in the region of the umbo; often with a wide rounded mesial ridge, extending from the beak to the front margin. Dorsal valve convex, with a large, flat or gently concave space just in front of the beak; sometimes with a shallow rounded mesial sinus extending from beak to front. Area of ventral valve varying from one to three lines in width at the beak; varying

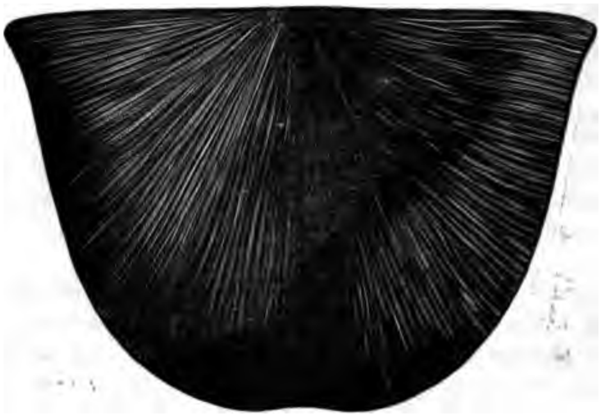


Fig. 119.

Fig. 119 —STROPHOMENA AMPLA.—Hall. Dorsal Valve.

also in the amount of its inclination to the plane of the lateral margin from 90° to 120° ; obliquely striated for one-third or one-half the distance between the foramen and the cardinal angles. Area of dorsal valve smaller than the ventral, of nearly a uniform width throughout, usually about half a line wide. Foramen small, linear closed, one-third of a line in width. From the point where the striation is discontinued the edge of the area of the ventral valve has a distinct narrow groove extending to the cardinal angle.

Surface with moderately fine, somewhat equal, sharp, irregular striæ, which bifurcate several times before reaching the margin ; the number also increasing by interstitial addition; crossed by small concentric striæ, which are usually more distinct in the spaces between the radiating striæ. The radiating ridges are sometimes of a uniform size all over the shell, six to eight in the width of two lines; in others larger near the beak than towards the margin, diminishing in size from three or four in two lines at the beak, to six or eight in the same width at the margin. The surface characters are very variable within a small limit, but the general aspect is that of a sharp or angular somewhat rugose striation. When the shell is partially exfoliated, it is seen to be perforated along the bottom of the grooves between the radiating ridges by small circular or oval pores, of which there are from two to seven in the length of one line. These are indicated on

the inner surface of the shell by irregular rows of small tubercles. It is probable that when perfect the surface is always covered with small spines, as seen in the following figure.

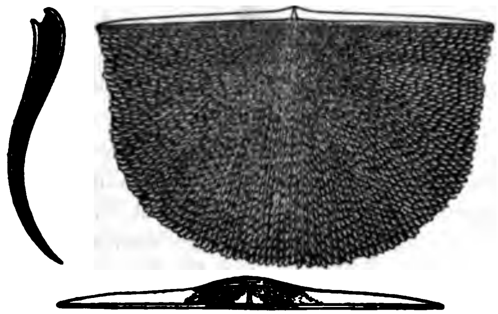


Fig. 120.

Fig. 120. *S. Ampla.*—Dorsal view of a specimen covered with spines, from the Corniferous Limestone. The lower figure shows the area and foramen; the left hand figure, the longitudinal section.

In the specimen above figured the spines are seated upon the crests of the radiating ridges. They are about two-thirds of a line in length, slightly curved, and appear to be tubular. They do not seem to have any connection with the pores of the shell, as these are situated, not on the radiating ridges, but in the grooves between them. In the interior of the ventral valve the muscular scars have very nearly the shape of those of *S. inæquistriata,* except that they are proportionally broader. The divaricators are divided into four or five longitudinal concave lobes by as many obscure ridges. At their anterior margins the shell is thickened so as to make a sort of elevated border. The rostral septum is, in some specimens, rudimentary, in others, well developed. The whole of the internal surface appears to be covered with small tubercles. These leave punctures in the cast of the interior.

I have only partly seen the interior of the dorsal valve. The divaricator processes resemble those of *S. demissa.*

Affinities and variations.—This species has in general a semicircular or broad semioval contour, but it sometimes approaches the triangular form from being narrowed towards the front. The form of the curvature of the valves is subject to innumerable modifications; the only constant curves being the general ones above stated. I think all the specimens in our collection from the Oriskany Sandstone, Corniferous

Limestone, and Hamilton Group, constitute but one species. The only variation that could be regarded as of specific importance are those of the area of the ventral valve above mentioned. In four of our specimens it forms a right angle to the plane of the lateral margin. In several others it forms an angle of about 120°, and taking these extremes it might well be thought that there are two species. But we have one fine specimen in which the angle is about 100°. I therefore think that this is not a variation of specific value.

In all the more general characters this species is precisely identical with *S. punctulifera*, (Conrad) and those allied therewith, which I have cited above from the 3rd vol. of the Pal. N. Y. The corniferous specimens are, upon an average, larger than those figured by Prof. Hall from the Lower Helderberg. This, however, of itself would not be of specific value. The only doubt I have as to the identity of this species with *S. punctulifera* rests upon the characters of the foramen of this latter. It is (at the time of writing this) not figured, but Prof. Hall thus describes it: "*Foramen nearly closed, with a narrow prominent callosity along the centre.*" In *S. cavumbona*, he says, "*Foramen small, narrow, closed by a callosity.*" In *S. Headleyana*, "*Foramen narrow, closed.*" In *S. Leavenworthana*, "*Foramen small, triangular, closed in full grown individuals.*" As there thus appears to be some difference, I strongly suspect that a series might be made out showing a gradation in the size of the aperture in all the above named species. In such poor specimens of the Lower Helderberg species as I have before me, the foramen cannot be observed at all. The surface characters and the form seems to me to be the same, and for the present it should be left an open question whether or not *S. ampla* is distinct from *S. punctulifera*.

Locality and Formation.—County of Haldimand, in the Oriskany Sandstone and Corniferous Limestone, Township of Bosanquet, in Hamilton Group.

Collectors.—A Murray, J. De Cew, E. De Cew, E. Billings.

Strophomena magnifica.—(Hall).

This is a large, nearly flat species, three or four inches wide. It resembles *S. perplana*. Our specimens are all very imperfect. It occurs in the Oriskany Sandstone, County of Haldimand.

STROPHOMENA MAGNIVENTRA.—(Hall).

Of this species, I have only seen some fragments, shewing casts of the area of the ventral valve and muscular impressions. It appears to be closely allied to *S. magnifica*, and occurs in the rock in the same localities.

The specimens of these two species in our possession agree exactly with Professor Hall's figures. I am endeavouring to procure materials to illustrate them properly.

Genus CHONETES.—(Fischer).

This genus differs from *Strophomena* in some internal characters, which cannot be very well described without the aid of good illustrations. The shells are in general much smaller than those of *Strophomena:* they are more evenly striated, and the cardinal edge of the ventral valve usually displays a row of small slender spines, which become gradually longer towards the angles. The area and foramen are similar to those of *Strophomena*, as are also (very nearly) the muscular impressions and divaricator process of the dorsal valve. The valves articulate by teeth and sockets, and in one species *(C. hemispherica)* the area of the ventral valve is striated.

Between twenty-five and thirty species have been described as occurring in the Devonian rocks in the neighbouring States, and it is thus almost certain that the four or five which occur in Canada include no form that has not been named. At present, I can identify only one.

CHONETES HEMISPHERICA.—(Hall).

CHONETES HEMISPHERICA × C. ARCUATA.—Hall. *Tenth Annual Report of the Regents of the University of New York*, p. 116–117.

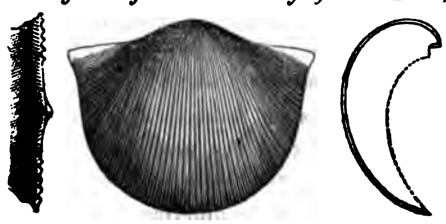


Fig. 121. Fig. 122. Fig 123.

Fig. 121.—*Chonetes hemispherica*, drawn from the largest specimen seen. Fig. 122.—View of the ventral valve. A portion of the ventral area, shewing the striation and the bases of five species. Since this figure was engraved, other specimens have been procured, shewing seven and eight spines. Fig. 123.—Longitudinal section, shewing the curvature of the ventral valve. [The dotted line representing the dorsal valve; conjectural, the valve not having been seen.]

Description.—This species resembles in shape some of the forms of *S. inæquistriata*, but it can always be distinguished therefrom by the surface, which is covered with fine crowded, rounded or sub-angular striæ of an uniform size, from eight to ten in the width of one-fifth of an inch, presenting that even aspect peculiar to the genus *chonetes*, and rarely exhibited by species of *Strophomena*.

The ventral valve is usually extremely convex, most prominent in the upper half; the umbo large—obtusely rounded, overhanging the hinge line; the cardinal angles compressed, reflected, forming short projecting scars; on the cardinal edge from five to eight small spines, rarely preserved, their bases only being visible. Area of ventral valve, in old specimens, owing to the extreme incurvation of the cardinal portion of the shell, inverted or brought under the body of the shell at right angles to the plane of the margin; in young specimens not so much inverted; its width about half a line, or a little more; obliquely striated, the striæ most distinct at the hinge line. Area of dorsal valve, very narrow—almost linear, the inner edge with a row of small pits for the reception of the serrated teeth of the opposite valve.

The width of this species is usually about one-inch on the hinge-line but it sometimes attains the size of one-inch and a half. Length equal to, or one-third less than the length.

The dorsal valve is seldom found, although the ventral valve is somewhat common. Of the former I have seen only two fragments, consisting of the hinge-line and a portion of the shell. One of these was in its natural connection with the ventral valve, and being silicified came away on immersion in acid; the divaricator processes are united at the base and separated above by a narrow fissure; they are grooved on the outside, the grooves converging towards the hinge-line so that when viewed from the side of the area they have the appearance of four small radiating ridges.

The muscular impressions and foramen have not been observed by me. The triangular opening in the area represented by Fig. 121, may be the foramen, but it seems to me to be a fracture.

Prof. Hall describes two species differing from each other in the size of the striæ; in *C. arcuata*, "sixteen occupying the space of one-fifth of an inch, while only one-half that number can be counted in the same space on *C. hemispherica*." (10th Regents, Rep., p. 117). Our specimens agree with the latter.

Locality and formation.—Oriskany Sandstone and Corniferous Limestone, County of Haldimand.

Collectors.—A. Murray; E. Billings; E. De Cew and J. De Cew.

Other Species of CHONETES and PRODUCTA.

Fig. 124. Fig. 125.

Fig. 124.—Two species of *Chonetes* undetermined.
125.—*Producta*. A small undetermined species. *a*.—Side view. *b*.—View of ventral valve.

Besides CHONETES HEMISPHERICA there are three or four other small species of the genus in the Corniferous Limestone and Hamilton Group in Canada West, but in the present condition of the literature of American Palæontology I cannot determine them. The student is referred to N. Y. Regents' Reports. Fig. 124 represents two species, one with the spines directed obliquely outwards and in the other erect. They are both from the Hamilton Group.

In the Corniferons Limestone we have also two small species of *Producta*. One of these (Fig. 125) is covered with nodular radiating ribs. The other is about the same size as the above but with a smooth tubercular surface.

Genus LEPTOCŒLIA ? Hall.

This genus as described by Professor Hall in the 12th Annual Report of the Regents, published in October or November 1859, seems to differ from *Centronella* only in consisting of species which have the surface ribbed instead of smooth. Professor Hall dates his genus back to 1856, but no description was published until the issue of the 12th Regents' Report and therefore should it be the same as *Centronella* it cannot be retained, as the latter has the priority. For the present I shall use it provisionally, not having seen the internal structure myself.

LEPTOCŒLIA ? FLABELLITES. (Conrad.)

ATYRPA FLABELLITES. (Conrad.) Annual Report on the Palæontology of New York for 1841, p. 55.

LEPTOCŒLIA PROPRIA + L. FIMBRIATA + L. DICHOTOMA.—Hall, in various works.

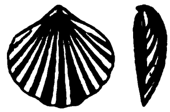


Fig. 126.

Fig. 126.—*Leptocœlia flabellites.*—Dorsal and side views.

Description.—Shell semi-elliptical, or sub-circular, or transversely oval. Dorsal valve nearly flat, with from ten to fourteen rounded or sub-angular ribs, one or two of which, in the middle, are usually separated from those on each side by grooves deeper and wider than the others and sometimes depressed so as to give the appearance of a mesial sinus; hinge-line either nearly straight or with the portions on each side of the beak forming an obtuse angle seldom so acute as 150°. Ventral valve moderately convex, often carinate along the middle, beak small, pointed, incurved down to the dorsal area; ribbed like the opposite valve.

Width from six to ten lines. Length a little less than the width.

Locality and Formation.—Oriskany Sandstone and Corniferous Limestone, County of Haldmand, Canada West, also in prodigious numbers in the Oriskany Sandstone at Gaspé, Canada East.

Collectors.—A. Murray; E. Billings; E. De Cew; J. De Cew, in Canada West. Sir W. E. Logan; J. Richardson; R. Bell, Gaspé.

LEPTOCŒLIA CONCAVA. Hall.

Fig. 127.

Fig. 127.—*Leptocœlia concava.* Ventral, dorsal and side views.

Description.—Ovate or nearly circular; length three or four lines; width equal to, or a little less than the length. Ventral valve convex sub-carinate along the middle. Dorsal valve flat or often concave. Surface with from ten to fourteen rounded radiating ribs.

This species closely resembles the *L. flabellites* but is never more than half the length or width. On comparison with specimens of *L. concava* from the Lower Helderberg of New York, I find so little difference that I do not see how those of the Corniferous Limestone are to be separated. In several the dorsal valve is not so deeply concave as it is in those from the lower rock, but in others it is. The

ribs are also in general coarser, but occasionally specimens with fine bifurcating ridges are found exactly like those from the shaly limestone of the Helderberg mountains.

Locality and Formation.—Oriskany Sandstone and Corniferous Limestone, County of Haldimand.

Collectors.—E. Billings; E. De Cew; J. De Cew.

LAMELLIBRANCHIATA.—(Blainville.)

In the Oriskany Sandstone, Corniferous Limestone, and Hamilton Group of Canada West, we find about twenty species of lamellibranchiate mollusca, mostly in a bad state of preservation. These with several exceptions must remain for future examination. I shall only notice the following at present:

Genus CYRTODONTA.—(Billings,) 1858.

CYPRICARDITES.—Conrad. *Annual Report on the Palæontology of New York*, 1841, p. 51.

MEGALOMUS.—Hall. *Pal. N. Y. Vol.* 2, p. 243. 1852. *Not characterized.*

CYRTODONTA.—Billings. Report of the Geological Survey of Canada, 1858, p. 179. Sub-genus VANUXEMIA, p. 189.

PALÆARCA + MEGAMBONIA—Hall. *Twelfth Annual Report of the Regents of the University of New York*, 1859, p. 10–13. Also CYPRICARDINIA?—Hall. Pal. N. Y. Vol. 3, p. 266. Not characterized. In part. Also PALÆARCA and MEGAMBONIA in same work. 1861.

Generic characters.—Equivalve, inequilateral; umbones near the anterior end; general form obliquely tumid, transversely sub-rhomboidal, ovate or sub-cordiform; posterior extremity larger than the anterior, which latter is often reduced to a small auriculate projection in front of the umbones; two muscular impressions, of which the posterior is superficial, and the anterior sometimes deeply excavated; several linear anterior teeth crossing the hinge plate, backwards and obliquely downwards, usually curved and in some species striated, situated either beneath or a little in front of the umbones; posterior teeth situated at or near the extremity of the hinge line, usually from two to five, elongate; pallial line simple; some of the species with a narrow area between or behind the beaks.

History of the Genus.

The somewhat numerous species which belong to this genus, have been variously distributed and shifted about among the genera *Ambonychia, Cardiomorpha, Edmondia, Modiola, Modiolopsis, Megambonia, Palæarca, Cypricardinia, Megalomus,* and *Cypricardites* in a very remarkable manner. Conrad, the first Palæontologist of the New York Survey, placed all the species, (twenty-three in number) described by him in a single genus, and I think that the many changes made by his successor in office, have not been productive of any improvement on that simple arrangement. The following are a few of the facts:

In the fifth Annual Report on the Palæontology of New York, Conrad, in 1841, characterized his genus *Cypricardites* and described sixteen species from the Silurian and Devonian rocks of the State. He did not give any illustrations, but it now appears that he prepared a figure, (shewing the characters of the hinge,) which, however, remained in Professor Hall's hands eighteen years without publication. In the 8th volume of the Journal of the Academy of Natural Sciences, Conrad described seven other species from the Devonian rocks of New York. These are all figured.

In 1847, Professor Hall suppressed the genus *Cypricardites* and substituted his own genus *Modiolopsis*, in which he placed all Conrad's Lower Silurian species. The following are his remarks in a note at the foot of p. 157, Vol. 1. Pal. N. Y.

"I find myself compelled to abandon the use of the name *Cypricardites*, as applied to shells differing so widely as these do from CYPRICARDIA, and belonging apparently to the MONOMYARIA and DIMYANIA. So far as it is possible to ascertain, none of the species of the older strata possess two muscular impressions, and therefore do not strictly fall under the genus *Cypricardites* of CONRAD, (Ann. Geol. Report, 1841, p. 51·)"

The principle upon which the above decision was given, is perfectly correct. It is one of the established laws of nomenclature that a name which involves a zoological error (such as referring a genus to the wrong place in the system of classification) should be excluded. The reasons given by Professor Hall for bringing *Cypricardites* within the operation of this law are not so well founded, because both *Modiolopsis* and *Cypricardites* have two muscular impressions. The correct reason is that the name implies a close relationship to the recent genus *Cypricardia*, which belong to the family CYPRINIDÆ

while the species in question constitute a group in the family *Arcadæ.* No Conchologist would think of admitting such a name as *Cypricardites* among the ARCADÆ.*

In 1858, I published the genus *Cyrtodonta* and its sub-genus *Vanuxemia*, and illustrated them fully by figures shewing the internal characters of several species. (See my Report for 1858.) About the same time Professor Hall described the same genus under the names of *Palæarca* and *Megambonia* the latter being identical with my sub-genus *Vanuxemia*. His descriptions were (as he says) printed in 1858, in the 3rd volume of the Palæontology of New York. At the foot of page 270 of that work the reader will find a note on the genus *Cypricardites* which shews very clearly that at the time the author had his new genera under consideration, Conrad's genus was also receiving some attention as it had on several previous occasions. When my Report was published, Professor Hall seeing that his genus *Palæarca* was too late, resolved if possible to revive *Cypricardites* for the purpose of suppressing *Cyrtodonta*. He therefore issued a small pamphlet of 18 pages, (being part of the 12th Ann. Rep. of the N. Y. Regents, in which he gives his descriptions, and in addition thereto a note pointing out the identity of *Cypricardites* and containing Conrad's figure. This probably appeared in May or June 1859, as it is noticed in the July No. of Silliman's Journal of that year. In 1860, the 3rd Vol. of the Pal. N. Y., was published, but without the plates. On page 523 of that work, I find the following statement:

"At the time that my examinations and descriptions of PALÆARCA were made (in 1857,) I had overlooked the genus CYPRICARDITES of Conrad, which was published in the Annual Geological Report for 1841. The description and figure correspond so nearly with the fossils which I have described that I feel compelled to adopt the prior name, which will include those described in this volume under the genus PALÆARCA, as well as those described by MR. BILLINGS under the genera CYRTODON and VANUXEMIA." (Compare the above with the note at the foot of page 270, Pal. N. Y., vol. 3).

As for myself, I must say that when I described the genus *Cyrtodonta*, I was aware of Conrad's description, but considered, as I do now, that the genus (having been suppressed by Professor Hall, and never acknowledged by palæontologists, or quoted by them except as

* See DANA in Silliman's Journal, 2nd Series, Vol. 28, p. 149. 1859.

a synonim) was perfectly obsolete. And as the name is decidedly inappropriate, I hold that it cannot be restored now.

I shall, in conclusion, direct attention to the uncharacterized genus, *Megalomus*. This name was proposed by Professor Hall in the 3rd volume of the *Pal.*, N. Y., as a generic appellation for a species which is a true *Cyrtodonta*. I have ascertained that it has the same curved anterior teeth, and although I have not seen the posterior teeth, there is not the least doubt but that they do exist. Now, it might be thought that *Megalomus*, having priority over *Cyrtodonta*, should take its place. I contend that this would not be the correct or the just course. In Professor Hall's description he has "overlooked" the generic characters, and only given those which are specific. All that he has described is not sufficient to constitute a genus. The best proof of this is, that the author cannot recognize it himself, as he has since described two other genera, *Palæarca* and *Megambonia*, which, if retained, would include *Megalomus*. I have been the first to describe correctly and illustrate this genus under a name that is in no respect inappropriate, and I have a right to retain that name against those which are objectionable or not founded on an intelligible generic description. I further consider *Megalomus* an inconvenient name, because it so closely resembles *Megaloma*, a genus of Gasteropods.

Sub-genus VANUXEMIA.

Fig 128.

Fig. 128.—*Vanuxemia Bayfieldii*—Billings, shewing the interior of left valve.

This sub-genus was proposed by me, to include those species of *Cyrtodonta* which have the beaks terminal, or nearly so, and the

anterior extremity reduced to a small auriculate expansion or obsolete. The above figure shews the teeth and muscular impressions of *V. Bayfieldii*, Hudson River Group.

VANUXEMIA TOMKINSI.—(N. Sp).

Fig. 129.

Fig. 130.

Fig. 129.—*Vanuxemia Tomkinsi.*—View of right side.
Fig. 130.—View of anterior side.

Description.—Ovate, exceedingly gibbous, cordiform; umbones very prominent; beaks closely incurved.

Placing the shell with the hinge-line in a horizontal position, we find that the line passing through the greatest length of the shell forms an angle with it (*i.e.* with the hinge-line) of about 45°; the apical angle, or the angle formed by the slope in both directions from the umbones is about 80°; both of these slopes extend about half the length of the whole shell; from their extremities the remainder of the margin on the posterior, ventral and anterior sides is rounded, somewhat pointed in the middle. At the anterior extremity of the hinge-line there appears to be a small auriculate projection, but this point is not very well preserved in the specimen.

Surface somewhat smooth, with obscure, concentric striæ, three or four in the width of one line. Besides these there are some obscure, shallow, concentric, undulations of growth.

The best preserved specimen is two inches and one-eighth in length —measuring from the umbones to the most projecting or pointed part

of the margin below. The greatest width (which is at mid-length, and nearly at right angles to the greatest length) is one inch and three quarters. Depth of both valves, at a little above the middle, one inch and a half. The umbones are elevated nearly half an inch above the hinge-line. The whole shell is pretty evenly convex, with a slight approach to a concave slope in front of the umbones. There appears to be an area, but our specimens do not shew it with sufficient clearness to warrant a positive opinion.

This species is dedicated to the discoverer, W. G. Tomkins, Esq., C. E. St. Mary's, Canada West.

Locality and Formation.—Corniferous Limestone, St. Mary's.

Collector.—W. G. Tomkins.

GASTEROPODA.—(Cuvier.)

We have in the Devonian Rocks of Canada West about 25 species of Gasteropoda of the genera *Euomphalus, Straparollus. Murchisonia, Pleurotomaria, Loxonema, Macrocheilus, Platyostoma and Platyceras.* Of these I shall only notice the following at present.

EUOMPHALUS DE CEWI.—N. Sp.

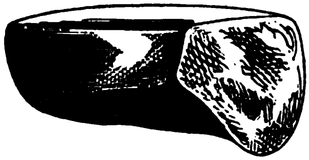


Fig. 131.

Fig. 132.

Fig. 131.—*Euomphalus De Cewi.*—A small specimen.
Fig. 132.—View of the umbilicus.

Description.—Shell from two to four inches in diameter; whorls about three. Spire nearly flat or gently concave; umbilicus deeply concave. The upper side of the whorls is nearly flat, with an angular edge all round the margin, (in casts narrowly rounded). The outside of the whorls nearly at right angles to the upper, but inclining a little inwards and gently convex. On the lower side there is a narrow rounded edge all round, from which there is a nearly uniform concave slope into the deep sub-hemispherical umbilicus.

The surface is marked with large slightly elevated lines of growth four or five in one line which on the upper side of the whorl curve backwards to the outer margin, and, then crossing the marginal edge curve forward for half the depth of the whorl on the outside, then backwards to the edge of the umbilicus within which they are not preserved in any specimen that I have seen. The aperture has the upper outer and inner sides nearly straight and at right angles to each other. The lower side is narrowly convex at the outer angle and then concave conforming to the curve of the umbilicus. In a nearly perfect specimen three inches across, the upper-side of the last whorl is full an inch wide at the aperture and the outer-side an inch and a half·

In general the spire is flat or gently concave but in some of the casts the two inner whorls are a little elevated above the plane of the outer one.

This fine species is closely allied to *Euomphalus trigonalis.*—(Goldfuss) of the Devonian rocks of Germany, but it is flatter above, and, according to Goldfuss' figures, the surface of that species is finely cancellated.

Dedicated to the discoverer Mr. J. De Cew, of Cayuga, C. W.

Locality and Formation.—County of Haldinand, Corniferous Limestone.

Collector.—J. De Cew.

STRAPAROLLUS? CANADENSIS.—(N. Sp.)

Description.—This species consists of a simple, cylindrical, slender, gradually tapering tube, coiled up so as to make a nearly flat disc about two inches and a half across. A transverse section of the tube is very nearly circular, which must also be the form of the aperture. The spire is nearly flat or gently concave. The umbilicus is widely but not very deeply concave. There are about four whorls. In specimens two inches and a half wide the diameter of the aperture is from seven to nine lines. The surface markings are not preserved in the specimens that I have seen. In one there are several concave transverse septa and it may be that this is a Cephalopod of the genus *Trochoceras* and not a Gasteropod. As however species of *Straparollus* are occasionally septate I shall place it in thatgenus provisionally.

This species is closely allied to *Euomphalus planorbis,* (Archiac and Verneuil) of the Devonian Rocks of Germany but has fewer whorls.

Locality and Formation.—County of Haldimand. Corniferous Limestone.

Collectors.—J. De Cew; E. De Cew.

LOXONEMA COTTERANA.—(N. Sp.)

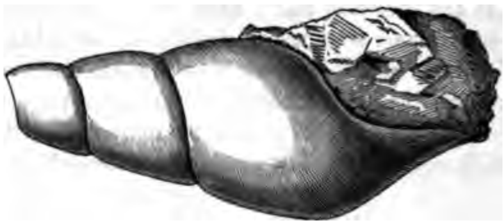


Fig. 133.

Fig. 133.—*Loxonema Cotterana.*

Description.—Elongate, fusiform, acute, apical angle, between 25° and 30°; whorls four to six; very depressed convex; body whorl large, occupying full one-half the whole length of the shell, descending with a uniform convexity into the aperture; aperture elongate ovate, effuse below, columellar lip extending about three-fourths of an inch below the body of the whorl. The suture in the cast deeply excavated, but narrow, the fissure descending into the fossil obliquely downward, the whorl below presenting a sharp edge over it, and the one above, an obtusely convex slope into it; this is the appearance presented when the suture is completely cleared of the shell. Surface unknown.

Length, three inches. Length of last whorl measured on a line passing longitudinally along the inner lip, one inch and a half; diameter of last whorl, one inch.

Dedicated to the discoverer, Miss Catherine Cotter, daughter of Col. G. S. Cotter, of the Township of Dunn.

Locality and Formation.—Lake Shore, Township of Dunn. Corniferous Limestone.

Collector.—Miss Catherine Cotter.

CEPHALOPODA.—(Cuvier).

In this class I estimate that there are twenty-five species of the genera *Orthoceras, Cyrtoceras, Phragmoceras, Nautilus,* and *Goniatites.*

CYRTOCERAS AMMON.—(N. Sp.)

Description.—Six to eight inches in length; section nearly circular; rather abruptly curved; a specimen, six inches in length, forming a half whorl, which would lie in a circle of four inches in diameter; the apical three inches, curved with a radius of about one inch and a half, more gently curved towards the aperture. Tube tapering from a diameter of fifteen lines at the larger extremity, to six lines at the smaller, in a length of six inches.

The shell of this specimen is beautifully ornamented by strongly elevated, encircling, waved ridges, of which there are forty-seven in the length of five inches and a half; these are distant from each other about three lines at the larger extremity, becoming gradually more and more approximated towards the smaller end—where the last two are scarcely a line distant. In their course round the shell, the ridges are undulated by short, zig-zag curves, from half a line to two lines wide, and one line, or a little less, in depth. In crossing the median line of the ventral aspect, they make a deep curve towards the apex, two lines deep near the aperture, and one line and a half wide, becoming gradually less as the diameter of the shell decreases. The ridges project abruptly from the surface of the shell to the height of half a line, the intervening spaces are flat, and nearly smooth, or with apparently obscure, concentric striæ.

The deep flexures of the encircling ridges along the ventral aspect seem to shew that the siphuncle is situated close to the margin on that side. The septa have not been observed. The aperture is not preserved in the specimen, but it is most probably circular.

The above description is founded upon a single specimen, which is nearly perfect, and has the shell preserved—but silicified.

Locality and Formation.—Township of Rainham, Corniferous Limestone.

Collector.—E. De Cew.

CYRTOCERAS BELUS.—(*N. Sp.*)

Description.—Six to eight inches long; curved so as to make about half of a whorl, of which the diameter would be about six inches. In a specimen seven inches long, measuring along the ventral aspect, the curve corresponds very nearly to that of a circle with a radius of three inches, and the remainder to one with a radius of about two inches. The cross section of the tube is transversely oval; the great-

est thickness, from side to side; the least, from the ventral to the dorsal aspect; the diameters having a proportion to each other of about ten or eleven to fifteen. The sides are narrowly rounded; the dorsal aspect uniformly depressed convex; the ventral aspect more strongly convex than the dorsal, and most prominent along the median line. In the cast of the interior there is close to the aperture a broad, shallow constriction, showing either that the shell is thickened on the inside at this point, or that the aperture is smaller than the greatest size of the tube. There is also an appearance which leads me to suspect that the aperture is obscurely trilobed. In the specimen above mentioned, the chamber of habitation is one inch and a half in depth. The first four septa occupy one inch in length of the tube, and the others become nearer to each other as they approach the apex. The siphuncle is about two lines in thickness and close to the margin, but not in contact therewith, there being in one specimen half a line and in another about a line between it and the shell. The latter appears to thin with obscure encircling striæ.

A specimen seven inches in length has a dorso ventral diameter of sixteen lines, at about one inch from the aperture; and it tapers to six lines at seven inches. The remainder to the apex is broken off and not preserved. The lateral diameter of this specimen cannot be ascertained, as it is partly imbedded in the stone. But in another, (a fragment) the diameters are, at the large end, 12 lines to 16 lines, and at two inches nearer the apex 7 to 11 lines.

There appears to be some variation in this species with regard to the distance of the septa. In one specimen the first two next the outer chamber are only two lines distant, and in another which appears to belong to this species there are six septa in one inch at three inches from the aperture.

Locality and Formation.—Corniferous Limestone, County of Haldimand.

Collectors.—E. DeCew, J. DeCew.

CRUSTACEA.

The Trilobites that have been determined are *Calymene Blumenbachii, Phacops bufo, Dalmanites calliteles*, and *Phillipsia ? crassimarginata*. Besides these, there are five other species belonging to the genera *Lichas, Dalmanites*, and *Phillipsia*,—in all nine species. There are also two species of *Leperditia*.

PISCES.

There appear to be three or four species of fish in the Oriskany Sandstone and Corniferous Limestone, one or two of them covered with plates resembling those of an *Asterolepis*. Dr. Newbury informs me that one of them is his *Agassizicthys Sullivanti*.

SUMMARY.

The following is a statement of the number of species in the Devonian Rocks of Canada West according to my estimation of the specimens in the Museum of the Survey :

	Determined.	*Undetermined.*
Zoophyta	54	10
Crinoidea	0	10
Bryozoa	0	18
Brachiopoda	47	10
Lamellibranchiata	2	18
Gasteropoda	4	21
Cephalopoda	2	23
Crustacea	4	5
Pices	1	3
	114	113

Nearly all of the species above given as determined will be found noticed in the several papers published in this Journal. Among those undetermined there must be a great many identical with those described in the publications of American Geologists. I shall endeavour to give some account of them in a few months.

ON THE KLAPROTHINE OR LAZULITE OF NORTH CAROLINA.

BY E. J. CHAPMAN.
PROFESSOR OF MINERALOGY AND GEOLOGY IN UNIVERSITY COLLEGE, TORONTO.

The Klaprothine or Lazulite is comparatively a rare mineral. It appears to have been first recognized by Widenmann in 1791, in the valley of the Muhr, near Krieglach in Upper Styria. By Werner, it was mistaken for Feldspar ; and, although examined by Klaproth, its true nature was not detected until the analysis by Fuchs of specimens

afterwards discovered near Werzen, in Salzburg. Brandes then re-examined the Krieglach specimens, and shewed their identity in composition with the examples analysed by Fuchs.* The other known localities of this mineral, comprise Vorau near Gratz in Styria, (examples from which spot have been analysed by Rammelsberg); the foot of the Wechsels near Therenberg in Lower Austria; Minas Geraes in Brazil; and Sinclair County in North Carolina. Specimens from this latter locality have been very carefully analysed by Professor J. Lawrence Smith, and George J. Brush (now Professor of Metallurgy in Yale College), but I have failed to discover in any publication, a crystallographic or mineralogical description of this North American lazulite. A specimen, however, consisting of numerous small crystals imbedded in fine-granular quartz or sandstone, having been kindly presented to me within the few last months, by Prof. T. Sterry Hunt, of the Geological Survey of Canada, I propose, in the present place, to offer a brief notice of its leading mineralogical characters.

All the earlier determinations of Lazulite crystals referred the mineral to the Trimetric or Rhombic System. Prüfer of Vienna was the first to maintain its Monoclinic character, and the angles given in the more recent works on Mineralogy are adopted from his measurements. The European crystals present in general a somewhat complicated aspect, although certain combinations closely resemble those of the Trimetric System. Two "augite pairs," are always present. These, according to Prüfer, measure respectively over a front edge 100° 20′ and 99° 40′, the difference being but little more than half-a-degree. According to the same observer, moreover, the inclination of the base on the prism-plane (0 P : ∞ P, in the notation of Naumann†) only differs from a right angle by 23 minutes. Were these values, consequently, all that we had to depend upon, it would be manifestly unsafe to rely upon them as proofs of the monoclinic crystallization of Lazulite. But in some combinations, the forms below the middle zone of the crystal are less numerous than those above this zone, or otherwise differ from the latter in their measurements. Nevertheless, in certain Trimetric minerals, and notably in Datolite and Wolfram, we have the same peculiarity, and we might therefore look

* Brandes appears, however to have missed the water, present in this substance: unless there be a typographical error in his recorded numbers. If we transpose these numbers, as regards the silica (an impurity) and the half-per-cent of water said to have been obtained, his analysis will agree closely with those of other chemists.

† = O : I in Dana's notation; and B : V in that of the writer.

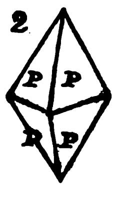
upon these Lazulite crystals as Trimetric combinations, hemihedrally modified. From my examination of the North Carolina specimens, I cannot but think that this view will in the end prevail. It is supported by the fact that in many combinations the upper and lower forms do actually correspond in number and character; and that practised crystallographers like Phillips and Lévy, skilled in the use of the goniometer, were unable to detect in their measurements the differences announced by Prüfer.*

The North Carolina crystals—presuming those in my possession to represent the generality of crystals obtained at this locality—although usually distorted, are of an extreme simplicity: contrasting remarkably in this respect with the majority of European examples. At first sight, they resemble a monoclinic prism terminated by a single "augite-pair" or hemi-pyramid; but they really consist (if monoclinic) of two hemi-pyramids, the four planes of one of which are greatly elongated; or, if trimetric (as I conceive them to be), they form a rhombic octahedron in which four planes, in opposite sets of two, are thus lengthened beyond the others. Fig. 1 represents this distorted aspect; Fig. 2, the same form (or combination, if monoclinic) in symmetrical proportions. These symmetrical crystals are of smaller size, and less numerous, than the distorted forms.

1

Although the edges of these crystals are sharply defined, the planes are unfortunately without lustre. The most careful measurements of five crystals, by means of a fixed or Adelmann's goniometer gave me the same angles for both the upper and lower faces. The difference found by Prüfer is too slight, however, to be satisfactorily detected by any kind of application goniometer. I attached, therefore, thin films of mica as carefully as possible to the planes of one of the crystals, and measured the angles by reflected light with a Wollaston goniometer of the best construction. The following table shews the measurements thus obtained, supporting the apparently Trimetric character of these crystals:

2



* These observers appear to be the only crystallographers who have practically examined crystals of Lazulite. Thus, the measurements of Phillips are followed by Hausmann, Breithaupt, and others; those of Lévy, by Dufrénoy; and those of Prüfer, by Naumann Dana, Quenstedt, and Miller.

	Upper Planes over front edge:	Lower Planes over front edge:
1st measurement......	100° 4′	...... 100°
2nd "	99° 99′	...... 99° 99′
3rd "	99° 99′	...... 100° 2′

	Upper Planes over side edge:	Lower Planes over side edge:
1st measurement......	97° 27′	97° 28′
2nd "	97° 30′	97° 26′
3rd "	97° 26′	97° 27′

	Front Planes over middle edge:	Back Planes over middle edge:
1st measurement......	134° 10′	134° 7′
2nd "	134° 10′	134° 12′
3rd "	134° 8′	134° 10′

Whether monoclinic or trimetric, these measurements should of course correspond. The two sets were taken, however, for greater satisfaction.

Adelmann's goniometer gave me 100°—100° 30′ over a front edge; 97°—97° 30′ over a side edge; and 134°—134° 30′ over a middle edge. If we look upon the mineral as Trimetric, and adopt the angle of 100° as the mean inclination over a front edge, with 91° 30′ for the value of the prism-angle (according to general adoption), the following angles and axial relations are obtained by calculation:

$$P : P \text{ (over a front edge)} = 100°$$
$$P : P \text{ (over a side edge)} = 97° \, 24\tfrac{1}{2}'$$
$$P : P \text{ (over a middle edge)} = 134° \, 12'$$

$$x \text{ (vertical axis)} = 1{\cdot}652.$$
$$\bar{x} \text{ (macrodiagonal)} = 1.$$
$$\breve{x} \text{ (brachydiagonal)} = 0.9741.$$

The measurements of Phillips give for the octahedral angles, as deduced by Hausmann, 99° 16′ (over front edge), 96° 39′ (over side edge) and 136° 20′ (over middle edge). The position of the crystals, as adopted by Phillips, is here changed however—his middle edge being made a front polar edge, and the reverse.

Many of these North Carolina crystals appear to possess another form, in addition to those enumerated above. This is the front polar or macrodome, occurring generally on two opposite edges only, and thus presenting a monoclinic character, but lying sometimes on only one edge, and being consequently (if the mineral be Trimetric)

a tetartohedral modification. It is a mere line, dull like the other planes, and too narrow to admit of satisfactory measurement. The crystals are sometimes implanted in one another, but I have not detected any definite twin-combinations. The crystals extracted from my specimen, together with those exposed on the surface of this, do not amount however to more than ten or twelve in number. The hardness of these crystals is equal to 5.75, or very nearly to 6·0. The sp. gr. (one determination only) I found to equal 3·108, a value corresponding sufficiently with that obtained by Smith and Brush (3·122). The cleavage I have not been able to determine in a satisfactory manner. The blow-pipe reactions are as follows:

In the closed tube, the assay gives off water and loses its colour, becoming yellowish or greyish-white.

Per se, it exfoliates and expands greatly in bulk, changes colour, tinges the flame green, and crumbles away without fusing.

In borax, it dissolves very easily, imparting to the glass a pale ferruginous tinge.

In salt-of-phosphorus, it dissolves also very readily, and with slight effervescence.

In carbonate of soda it dissolves partially, but the dissolved portion is in great part precipitated as the glass cools, forming a white enamel. If the bead be dissolved in a little boiling water, a drop of nitric acid added to decompose the excess of carbonate of soda, and the clear supernatant liquid be then poured upon a small crystal of nitrate of silver, a yellow precipitate of phosphate is at once obtained. In employing this test for phosphates, the beginner should be cautioned, however, that silicates (if decomposable by carb. soda,) will produce the same reaction, but the silica may be eliminated by adding several drops of acid, and evaporating to dryness. By treatment with salt-of-phosphorus, moreover, silicates are at once recognized. If the solution of our mineral, as obtained above, be treated with acetate of lead, the precipitate presents the well-known blowpipe reaction of phosphate of lead, *i.e.*, the formation of a faceted globule without reduction.

Two analyses of the North Carolina lazulite are given by Professors Smith and Brush in the *American Journal of Science and Arts* for September, 1853. These exhibit the following results:

	1.	2.
Phosphoric acid...........	43·38	44·15
Alumina	31·22	32·17
Protoxide of Iron........	8·29	8·05
Magnesia	10·06	10·02
Water.........................	5·68	5·50
Silica (an impurity)	1·07	1·07
	99·70	100·96

From the above values, Messrs. Smith and Brush have deduced the annexed formula:—2 [3 (MgO, FeO), PO^5] + 5 Al^2O^3, 3 PO^5 + 5 HO.

The true position of Lazulite, in a natural classification, appears to be amongst a group of phosphates containing both anhydrous and hydrous species (the distinction between these being entirely artificial), and in some of which fluorine is also present. In this group I would place the following minerals:—Childrenite, Wavellite, Fischerite, Turquoise, Lazulite, Wagnerite, Herderite, Amblygonite, Monazite, Xenotime, and Cryptolite.

SELECTED ARTICLES AND TRANSLATIONS.

ON THE CO-EXISTENCE OF MAN WITH CERTAIN EXTINCT QUADRUPEDS, PROVED BY FOSSIL BONES (FROM VARIOUS PLEISTOCENE DEPOSITS) BEARING INCISIONS MADE BY SHARP INSTRUMENTS.

BY M. E. LARTET,
FOREIGN MEMBER OF THE GEOLOGICAL SOCIETY OF LONDON.

[The general interest occasioned by the recently admitted occurrence of extinct remains in association with objects of human art, induces us to transfer to our pages the following interesting letter from the pen of M. Lartet, published, with some additional notices by Mr. Leonard Horner, in a late Number of the *Quarterly Journal* of the London Geological Society (No. 64, November 1860.) By some accident, this Number of the *Journal* did not reach us until greatly after date.]

To the President of the Geological Society of London, L. Horner, Esq.:

"You have been good enough to offer to communicate to the Geological Society the observations which I have for some time past

made upon fossil bones exhibiting evident impressions of human agency. The specimens of them which I showed to you yesterday were those only whose origin is authentic, and which were obtained from deposits well defined in regard to geological relations. Thus the fragments of the Aurochs exhibiting very deep incisions, apparently made by an instrument having a waved edge, and the portion of the skull of the *Megaceros Hibernicus*, in which I thought I recognized significant marks of the mutilation and flaying of a recently slain animal, were obtained from the lowest layer in the cutting of the Canal de l'Ourcq, near Paris. These very specimens are figured or mentioned by Cuvier (Oss. Fossiles, 4to. 1823, tom. iv. pl. 6, fig. 9, *M. Hibernicus*); and Alex. Brongniart (Descr. des Environs de Paris, 4to. 1822, p. 562, pl. 1 A. fig. 10) has given a detailed description of the deposit, consisting of distinct layers, which he considers to be of higher antiquity than those of the valleys. The bones of the Aurochs and the *Megaceros* were found in the same layer as the remains of the Elephant (*Elephas primigenius*) of which Cuvier has given figures of two molars, which, according to that author, had not been rolled, and were found under circumstances which showed that they were in an original and not in a *remanié* deposit. I have said that the deep incisions on the bone of an Aurochs from the cutting of the Canal de l'Ourcq (which you may remember I showed you in the Gallery of the Jardin des Plantes) appear to have been made by an instrument with a waved edge. By this I meant an instrument having an edge with slight transverse inflections, so as to produce, by cutting obliquely through the bone, a plane of section somewhat undulated. The cut seems to have been made by a hatchet not entirely finished—a state in which the greatest part of the flint implements from St. Acheul, near Amiens, seem to be; but in the marked bones of Abbeville and other ancient localities the incisions must have been made by rectilinear edges. These considerations would lead us to think that, independently of the case of the hatchets simply chipped and roughed out, the place for the manufacture of which might be near that where they are now found, those primitive people must have been provided with more perfect instruments, such as would be more suited to their ordinary wants. I should therefore hesitate to adopt the system (too absolute, in my opinion) of Mr. Worsaae, who distinguishes the first subdivision of the "Stone Period" by hatchets that are merely chipped, to the exclusion of

those that are polished, which he assigns to the second subdivision. It is to be presumed that the want of instruments with polished surfaces and having a fine cutting edge must have been felt from the earliest time, when the people had learned to fix, by a much more difficult process, to flints and other rocks intentional forms so well defined.

Among the bones with incisions obtained from the sands of Abbeville, there is a large antler of an extinct Stag, referred to the *Cervus Somonensis*, or the *grand Daim de la Somme* of Cuvier, together with several horns of our common Deer, which I was not able to show you. The bones of the *Rhinoceros* (*Rh. tichorhinus*) which I laid before you were found at Menchecourt, a suburb of Abbeville, where there are gravel-pits which formerly afforded many fossil bones of Elephants, &c., and where M. Boucher de Perthes, at a later period, obtained the flints worked by human hands. The incisions that may be observed on those bones are neither so deep, nor do they afford evidence so striking, as those in the bones of the Aurochs from the Canal de l'Ourcq; but the shallow cuts and the incisions of the bony surfaces which may be observed upon them, especially in the articulations, have in my eyes not less value; for I have satisfied myself, by comparative trials on homologous portions of existing animals, that incisions presenting such appearances could only be made in fresh bones still retaining their cartilage. As to the fragment of the horn of the *Megaceros Hibernicus*, which Cuvier had received from England without any indication as to where it came from, you may have observed that it bears the marks of several blows, which have made incisions of a depth that it would be impossible to produce in the present state of mineralization of that fragment; further, the blow which detached that piece from the rest of the horn must have been given before that immersion in the sea which caused its fossilized condition; for in the internal cavity of this fragment there was found the valve of an *Anomia* (preserved with the specimen), which could not have found its way there except at the place of fracture. I have observed very significant marks, evidently produced by a sharp tool, on the horn of a young *Megaceros* which the late M. Alcide d'Orbigny had received from Ireland some years ago.

I would call to your recollection that the Rev. John Cumming, in his geological description of the Isle of Man, (*Quarterly Journal* of the Geological Society, vol. ii. p. 345), notices the occurrence of the

remains of the *Megaceros* imbedded in blue marl "with implements of human art and industry, though of an uncouth and ancient character;" and in a note at the foot of page 344, alluding to a submarine forest, to which he is inclined to assign a more ancient date, he says, "It is singular that the trunk of an oak tree, which has been removed from the submerged forest at Strandhall, exhibits upon its surface the marks of a hatchet." With regard to the historical existence of the *Megaceros*, after referring to what is to be found in the works of Oppian, of Julius Capitolinus, and S. Münster,* I have found nothing which appears to me to justify in this respect the opinion put forth by Dr. Hibbert, and since then accepted by other palæontologists, except Professor Owen, who, speaking of the *Megaceros* of the British Isles, entirely dissents from the opinion of Dr. Hibbert. All the remains of that animal found on this side of the Channel, which I have examined, belong to deposits of greater antiquity than that of the peat-bogs.

M. Delesse has shown you fragments of bone that have been sawn, which he recently obtained from a deposit in the neighbourhood of Paris, where he had previously collected remains of the Beaver, the Ox, and the Horse. From an examination of these fragments, I have satisfied myself, by experiments on recent bones, that the action of a metallic saw would not produce the transversally striated plane of section which you must have observed on those ancient bones collected by M. Delesse; but I have obtained analogous results by employing as a saw those flint knives, or splinters with a sharp chisel-edge, found in the sands of Abbeville.

If, therefore, the presence of worked flints in the diluvial banks of the Somme, long since brought to light by M. Boucher de Perthes, and more recently confirmed by the rigorous verifications of several of your learned fellow-countrymen, have established the certainty of the existence of Man at the time when those ancient erratic deposits

* For the text of Oppian I have consulted the French translation of the poem "de la Chasse" by Belin de Balu (1787), chant second, p. 42. Julius Capitolinus is quoted by Aldrovandus, 'de Quadrupedibus bisulcis,' lib. i. c. xxviii. p. 857. Aldrovandus explains why he has changed his opinions after having received from an English physician the head of (*Megaceros*) *Euryceros*, which he has figured. There is another citation, and some conclusions interesting to read, at page 742 of the same work.

With regard to S. Münster, I have not taken notice of more than plate 9. fig. 2. of his "Cosmographia Universalis." But you will find his text reproduced and interpreted by Dr. Hibbert in the *Edinburgh Journal of Science*, 1830, vol. ii. p. 307. Dr. Hibbert has likewise given the figures of Münster, which are evidently fantastical, as admitted by the most eminent men of science in Germany.

were formed, the traces of an *intentional operation* on the bones of the *Rhinoceros*, the *Aurochs*, the *Megaceros*, the *Cervus Somonensis*, &c., supply equally the inductive demonstration of the contemporaneity of those species with the human race.

It is true that certain of those species, the *Cervus elaphus* of Linnæus (the same as your Red-deer or Stag) and the Aurochs, are still represented in existing nature: but although it is exactly the bones of the Aurochs which exhibit the most evident proof of human action, the fact is not of less value as regards the relative antiquity; for the remains of the Aurochs have been found associated in the same beds with those of *Elephas* and *Megaceros*, not, as I have already said, by the effect of a *remaniement*, but in an original inhumation. Moreover, fossil remains of the same Aurochs, have been found in England, in France, and in Italy, in præglacial deposits (that is, in deposits anterior to the most ancient pleistocene formations containing bones of *Elephas primigenius* and *Rhinoceros tichorhinus*). I would add, that the more rigorous observation of facts tends clearly to demonstrate that a great proportion of our living Mammifers have been contemporaneous with those two great extinct species, the first appearance of which in Western Europe must have been preceded by that of several of our still existing quadrupeds.

In endeavouring to connect those proofs of the antiquity of the human race with the geological and geographical changes which have since taken place, I have not met with any more precise induction than that offered by M. d'Archiac, viz. the relative epoch of the separation of England from the Continent. The former connexion of the two is a fact generally admitted: it is proved by the similarity in structure of the opposite sides of the Channel, by the identity of species of terestrial animals, the original intermigration of which could only have been effected by the existence of *terra firma*. M. d'Archiac (Bull. de la Soc. Géol. de France, 1ère série, t. x. p. 220, and Histoire des Progrès, &c., t. ii. pp. 127 and 170) has been led, by a series of well-weighed inductions from stratigraphical considerations, to consider the epoch of the separation of the British Islands as occurring after the deposition of the diluvial rolled pebbles, and before that of the ancient alluvium, the Loess of the North of France, of Belgium, the Valley of the Rhine, &c. The inference to be drawn from that hypothesis is self-evident: it is this,

that the primitive people to whom we attribute the hatchets and other worked flints of Amiens and Abbeville might have communicated with the existing land of England by dry land, inasmuch as the separation did not take place until after the deposit of the rolled diluvial pebbles, from among which the hatchets and worked flints have been collected. On the other hand, M. Elie de Beaumont having assigned the production of the erratic phenomena existing in our valleys to the last dislocation of the Alps, we should be authorized to conclude from this second hypothesis, that the worked flints carried along with the pebbles in that erratic deposit in the bottom of the valleys afford a proof of the existence of Man at an epoch when Central Europe had not yet reached the completion of its present great orographic relief.

While it has been held that no change has taken place in the great lines of level since the formation of the erratic deposits in the lower parts of our valleys, and although such changes cannot be distinctly traced in the central parts of the continents, from the absence of standards of comparison, they are not the less easy to be recognised as having occurred, even since the existence of Man, throughout the whole extent of the European coasts, from the Gulf of Bothnia to the very eastern extremity of the Mediterranean. They have been observed by different authors on a considerable number of points of the coast, where they have verified the existence of objects of human industry in deposits of marine origin, raised up at different elevations above the sea-level. Such changes, be they the result of action more or less violent, of movements more or less sudden, have not amounted to catastrophes so general as to affect to a sensible degree the regular succession of organized beings.

We find incontestible proof of this in the British Islands, whither the most considerable number of terrestrial species must necessarily have immigrated prior to the separation of those islands from the Continent, and where they have established themselves and have continued by successive generations to the present day. The same thing has occurred on the Continent, where the same terrestrial fauna has continued without any other modification than the geographical displacement of certain species and the final disappearance of some others—disappearances that have resulted, not from a simultaneous destruction, but rather from a series of successive extinctions which appear to have been equally gradual as regards space and time.

I may add to what I have stated above, that the finding of worked flints in the diluvium of Amiens and Abbeville is by no means an isolated fact. M. Gosse of Geneva, a young medical student in Paris, has recently discovered in the sands of the Parisian suburb of Grenelle, of the same age as those of Abbeville and of other parts of Europe, a flint hatchet of a most distinct form, together with knives or thin plates split in a longitudinal direction. I myself have had an opportunity of verifying these facts in the collection formed by that skilful explorer. He has shown me an Elephant's tooth, a canine tooth of a large Feline animal, and bones of the Aurochs, Horse, &c., all obtained from the same sands and from the same bed in which the flint hatchet was found.

I may add that, among the bones obtained in Switzerland under the lacustrine habitations of the Stone Period (in the lakes of Moosdorf, Bienne, and others), there never have been found any remains of the *Megaceros*, although the remains of the Elk, the Aurochs, and the *Bos primigenius* are by no means rare. In Denmark, where still more ancient stations have been carefully examined with the same object, Prof. Steenstrup has assured me that he has never discovered the smallest fragment of the *Megaceros* in the midst of the most abundant remains of the Reindeer, Elk, Aurochs, and other species of animals which from time immemorial have not existed in that region. Nevertheless these primitive stations in Denmark are referred back to a period when no other domestic animal existed in that country except the Dog. No remains have been found either of the Horse, Sheep, or Goat,—not even any kind of dwarf Ox.

If, Sir, you are of the opinion that the above notes, drawn up in haste, are likely to prove interesting to the Geological Society of London, I should be happy if you would submit them to the enlightened judgment of your learned associates, and if they will receive them at the same time as a mark of my deference, and as a feeble expression of the profound gratitude I feel for the honour conferred upon me by my name having been inscribed among the Foreign Members of that Society.

Addition by the President of the Geological Society,—L. Horner, Esq.

In the foregoing communication, M. Lartet has referred to my friend M. Delesse having shown me some fragment of bone bearing

incisions made by a sharp instrument, which he had recently discovered in the neighbourhood of Paris. He presented me with one of those which he had submitted to the examination of M. Lartet, and which I now lay before the Society, together with the following copy of a note I received from M. Delesse describing this specimen:—

"I send you a fragment of a rib which I recently found at Ver, i the department of the Seine et Oise, about nine leagues from Paris, at the depth of three mètres (nearly ten feet), in a kind of cleft filled by the diluvial soil (*le terrain diluvien*), occuring with the sandstone and sands belonging to the *étage* denominated *les sables de Beauchamp*. It was associated with divers bones of the Stag and Horse, and also of an animal no longer existing in the country, namely, the Beaver. I have submitted this fragment to M. Lartet, with whose profound scientific attainments you are well acquainted but he has not been able to decide whether it belongs to a species of quadruped still living, or to one now extinct. But he considers this small fragment of a rib very interesting, from its having at one extremity traces of a rude operation of sawing, and presenting an appearance very different from that which would be produced by a metallic blade or by a saw. M. Lartet did not rest satisfied with a mere conjecture, but ascertained by experiments on a fresh rib of an Ox that a metallic blade produced an uniform and almost a smooth cut. Hence he concludes that the rib in question had been sawn by flint with a jagged edge. Taking a splinter of flint with a chisel-edge from the sands of Abbeville, he easily sawed a fresh rib, but always obtained an uneven, irregular cut (*des surfaces de resection avec reprises nombreuses*), such as may be observed on the specimen I send you. There is therefore every reason to believe that this rib had been sawn by a flint, and it affords proof of Man having lived in France at the same time as the Beaver, an animal no longer existing with us; and M. Lartet has thus supplied a new and elegant demonstration of the contemporaneity of Man and quadrupeds during the period of the *Terrains diluviens*."

Subsequent Addition by the President of the Geological Society.

The day after the above communication was read, on showing the fragment of bone given to me by M. Delesse above referred to, it was observed that it had a remarkably fresh appearance, that it did not adhere (*happer*) to the tongue as fossil bones usually do, and

that thus a doubt might exist as to its assumed antiquity. After hearing this remark, I exposed a minute fragment to the flame of a candle, when it gave out the odour of burnt animal matter; and on immersing another fragment in hydrochloric acid, after effervescence, a soft gelatinous substance, nearly the size of the original fragment, was left. Knowing full well that M. Delesse and M. Lartet would cordially agree on the importance of the most scrupulous investigation of every fact produced in evidence on this recently-agitated question of the antiquity of Man, I communicated to both of them what I have stated above respecting this bone. I received immediately answers from them; and these, with their leave, I now give, not only because of their confirmation of the opinions they formerly expressed, but as containing some additional remarks of much interest.

M. Delesse, in his letter dated the 19th instant, says:—

"The specimen of the rib which I gave you was incontestibly found in a sand-pit (*sablonière*), where it was associated with the bones of animals no longer existing in the country—as, for example, the Beaver. I would observe that the presence of gelatine can in no way be opposed to the antiquity of that rib. I have only just now brought to a conclusion a long series of researches by which I have shown that bones even of a high antiquity still retain a notable proportion of organic matter. If you take the bones of an *Ichthyosaurus* from the Lias, or of reptiles from the Muschelkalk, you will easily satisfy yourself that, in spite of their great antiquity, they still contain a very notable proportion of organic matter. Coprolites from the oldest formation contain it. On the other hand bones comparatively recent, such, for instance, as those found in caverns or in travelled materials, have no great amount of organic matter. In brief, the preservation of organic matter in bones is very irregular; it depends on the nature of the rock in which they are found, at least quite as much as on their antiquity.

"I pronounce no opinion as to the nature of the instrument that had been employed in sawing that rib, for I made no experiments on the subject; but M. Lartet, whose caution and sagacity are known to you, made a special examination of the question along with eminent physiologists; and they had no doubt that the rib had been cut by a sharp flint."

M. Lartet, in his letter dated the 22nd instant, states as follows:—

"I am sorry to learn that a somewhat hasty objection has been made to the palæontological value of the fragment of bone which you exhibited. I have no right to give any opinion regarding the locality where it was found, because I have not visited it; but the opinion of M. Delesse, who had an opportunity of examining all its geological features, is deserving of all confidence. Among the other fossil remains which he found in that locality, there is a fragment of bone of a Horse, having also traces of human agency, and which is in a much more altered condition than that of the bone he gave you; but there is another fragment also bearing the mark of a saw, the appearance of which is quite as fresh as the specimen in your possession; nevertheless, when we endeavoured to authenticate this fragment specifically, we were unable to do so by comparing it with the homologous part in the skeleton of our living animals.

"It is moreover important to remark that, in any given locality, all the bones collected do not present the same degree of organic change. That depends, first, on their anatomical structure being more or less compact according to the species, and again, chiefly on the composition and physical condition of the mineral matter in which they have been in immediate and prolonged contact. Mr. Hart, in his description of the *Megaceros Hibernicus* (Dublin, 1830), states that a fragment of a rib analysed by Dr. Stokes yielded 42·87 per cent. of animal matter; and Dr. Apjohn, who analysed another portion of a rib, states as follows:—'The bone was subjected for two days to the action of dilute muriatic acid; and when examined at the end of this period, it had become as flexible as a recent bone submitted to the action of the same solvent. The cartilage and gelatine had not been perceptibly altered by time.' It is long since the observation was made by many other persons, and especially by Schmerling (Recherches sur les ossements des cavernes de la province de Liége, 4to. 1833, 1ère, par. pp. 18–52): and the remarkable researches on this subject recently made by M. Delesse, and which he is about to publish, have demonstrated that the organic change in bones by no means bears a relation to their palæontological antiquity. For example, he has found that the teeth of the bone-bed in the Upper Keuper at Otterbronn contain more azotized organic matter than most of the tusks of the Mastodon and Elephant found in tertiary or diluvial deposits. The amount of azote which they yield is even almost double that in the tusks of the Mastodon in the

Miocene limestone of Sansan or in the Miocene deposits of the Upper Garonne. Thus it is evident that, if the amount of organic matter generally diminishes in proportion as the age increases, there are, nevertheless, exceptions to that general rule.

"As to external appearance, that depends also on the circumstances of the locality. It is not long since a large number of bones of the *Hyæna spelæa* were sent to me, which had been obtained from an ancient alluvial deposit in the centre of France. They were in no degree changed in weight or colour, and in external appearance they were quite as fresh, if not more so, than the fragment given to you by M. Delesse. I have some of them now in my possession; and they are still so much impregnated with animal matter, that I was able with the utmost ease to saw and cut them with a flint knife. On the other hand, I have now before me a statuette made of stag's horn, obtained from a grave at the external base of a barrow, certainly not older than the 12th century, the substance of which is so much altered that it might be said to be fossilized, in a certain sense of the term, as much as the greater part of those found in caverns or diluvium. Hence we perceive that the greater or less amount of alteration in bones is not a character from which we can absolutely determine their palæontological antiquity.

"With regard to the mode by which the fossil bones of M. Delesse have been sawn, I must confess that at first sight I thought, as M. Desnoyers did, that the operation must have been performed with a metallic plate; but upon a more attentive examination of recent bones, I became convinced that the peculiar appearance presented by the section of one of the bones in the possession of M. Delesse must have been produced by the employment of a sharp tool of *flint*, rather than by a metallic plate, which has always given me a section with a very different surface. I send you the extremity of a tooth of *Hyæna spelæa*, which has been sawn by a flint. If you examine with a magnifying glass the plane of the section, you will find the same system of *striæ* as are observed in the bones collected by M. Delesse, sawn with the same kind of tool. You may further satisfy yourself that in this fragment nearly all the organic matter remains, although the tooth comes from an ancient deposit."

In my letter to M. Lartet I had said that when his communication was read, Dr. Falconer observed that, a considerable time ago, M. Marcel de Serres had given an account of a fossil Stag's horn that

had evidently been cut. On this M. Lartet observes—"It is very true, as Dr. Falconer remarked, that M. Marcel de Serres gave a figure in 1839 of a Stag's horn cut and fashioned by human hands. I had occasion to remark that, a long time before, M. Tournal in 1829 (Ann. des Sc. Nat. 1829, t. xviii. pp. 242 *et seq.*) and Schmerling in 1833 (*loq. cit.*) had made similar observations. I might myself have stated that among the bones of caverns I had seen those of the Rhinoceros and the Reindeer bearing marks that must have been made by man; but I was on my guard against bringing forward those facts, because they would only have afforded opponents an opportunity of bringing forward anew their favourite objection, viz. 'that nothing that had been observed in caverns was deserving any confidence, and that the traces left by man on fossil bones might have been made a long time after the introduction of the bones into the caverns.'

"What constitutes the whole value of my observations on the impressions or marks of human agency on the fossil bones found in the diluvial deposits of Abbeville, and in the cutting of the Canal de l'Ourcq, is this, that, once admitting the reality of those marks, their relative antiquity becomes rigorously demonstrated by the geological circumstances of their locality being clearly defined. At Abbeville the marked bones, as well as the flint hatchets, were found in the diluvial gravel, which is itself covered by the Loess deposit. In the cutting of the Canal de l'Ourcq, the bones of the *Aurochs* and those of the *Megaceros Hibernicus* were found at a depth of 7 mètres (23 feet,) in a bed of earth (*limon*) and under other beds in normal stratification. They were not rolled (as Cuvier has said,) and were mixed with the remains of an Elephant, and evidently under the conditions of an original deposit.

"At the meeting of the Geological Society of France yesterday evening, M. de Verneuil exhibited a worked flint hatchet, and an Elephant's tusk found in the gravel-pit of Précy, near Creil, in the valley of the Oise. Thus these worked flints have been found in the diluvium of three of our valleys—of the Somme, the Seine, and the Oise."

ON COMBUSTION IN RAREFIED AIR.

BY DR. EDWARD FRANKLAND, F.R.S.

(*From the Proceedings of the Royal Society. Vol. XI., No. 43.**)

"In the autumn of 1859, whilst accompanying Dr. Tyndall to the summit of Mont Blanc, I undertook at his request some experiments on the effect of atmospheric pressure upon the amount of combustible matter consumed by a common candle. I found that, taking the average of five experiments, a stearin candle diminished in weight 9·4 grammes when burnt for an hour at Chamounix; whilst its ignition for the same length of time on the summit of Mont Blanc, perfectly protected from currents of air, reduced its weight to the extent of 9·2 grammes.

"This close approximation to the former number under such a widely different atmospheric pressure, goes far to prove that the rate of combustion is entirely independent of the density of the atmosphere.

"It is impossible to repeat these determinations in a satisfactory manner with artificially rarefied atmospheres, owing to the heating of the apparatus which surrounds the candle, and the consequent guttering and unequal combustion of the latter; but an experiment in which a sperm candle was burnt first in air under a pressure of 28·7 inches of mercury, and then in air at 9 inches pressure, other conditions being as similar as possible in the two experiments, the consumption of sperm was found to be,—

"At pressure of 28·7 inches' 7·85 grms. of sperm per hour,
" 9·0 " 9·10 " "

thus confirming, for higher degrees of rarefaction, the result previously obtained.

"In burning the candles upon the summit of Mont Blanc, I was much struck by the comparatively small amount of light which they

* Paper received, February 28th; Read, March 7th, 1861.

emitted. The lower and blue portion of the flame, which, under ordinary circumstances, scarcely rises to within a quarter of an inch of the apex of the wick, now extended to the height of $\frac{1}{8}$th of an inch above the cotton, thus greatly reducing the size of the luminous portion of the flame.

"On returning to England, I repeated the experiments under circumstances which enabled me to ascertain, by photometrical measurements, the extent of this loss of illuminating effect in rarefied air. The results prove that a great reduction in the illuminating power of a candle ensues when the candle is transferred from air at the ordinary atmospheric pressure to rarefied air. It was, however, found that, owing to the circumstances mentioned above, no satisfactory quantitative experiments could be made with candles in artificially rarefied air, and recourse was therefore had to coal-gas, which, although also liable to certain disturbing influences, yet yielded results, during an extensive series of experiments, exhibiting sufficient uniformity to render them worthy of confidence. The gas was in all cases passed through a governor to secure uniformity of pressure in the delivery tubes. A single jet of gas was employed as the standard of comparison, and this was fixed at one end of a Bunsen's photometer, whilst the flame to be submitted to various pressures, and which I will call the experimental flame, was placed at the other. The experimental flame was made to burn a uniform amount of gas, viz. 0·65 cubic foot per hour in all the experiments.

"The products of combustion were completely removed, so that the experimental flame, which burnt with perfect steadiness, was always surrounded with pure air, the supply of which was, however, so regulated as to secure a maximum of illuminating effect in each observation.

"In all the following series of experiments, the illuminating power given under each pressure is the average of twenty observations, which accord with each other very closely. In each series, the maximum illuminating effect, that is the light given by the experimental flame when burning under the full atmospheric pressure, is assumed to be 100. The following is a summary of the results:—

1st Series.

Pressure of air in inches of mercury.	Illuminating power of experimental flame.
29·9	100·
24·9	75·0
19·9	52·9
14·6	20·2
9.6	5.4
6.6	·9
2nd Series.	
30·2	100·
28·2	91·4
26·2	80·6
24·2	73·0
22·2	61·4
20·2	47·8
18·2	37·4
16·2	29·4
14·2	19·8
12·2	12·5
10·2	3·6

"These numbers indicate that even the natural oscillations of atmospheric pressure must produce a considerable variation in the amount of light emitted by gas-flames, and it was therefore important to determine, by a special series of observations, this variation in luminosity within, or nearly within, the usual fluctuations of the barometrical column. In order to attain greater delicacy in the pressure readings in these experiments, a water-guage was used, but its indications are translated into inches of mercury in the following tabulated results, each of which represents, as before, the average of twenty observations.

3rd Series.

Pressure of air in inches of mercury.	Illum. power of exp. flame.
30·2	100·
29·2	95·0
28·2	89·7
27·2	84·4

"It is thus evident that the combustion of an amount of gas which would give a light equal to 100 candles when the barometer stands at 31 inches, would give a light equal to only 84·4 candles if the barometer fell to 28 inches.

"An inspection of all the above results shows that the rarefaction of air, from atmospheric pressure downwards, produces a uniformly diminishing illuminating power until the pressure is reduced to about 14 inches of mercury, below which the diminution of light proceeds at a less rapid rate. The above determinations give approximately 5·1 per cent. as the mean reduction of light for each diminution of 1 inch of mercurial pressure down to 14 inches. I am now extending this inquiry to pressures exceeding that of the atmosphere, and hope soon to lay before the Society the detailed results of the whole series, together with some observations on the causes of this variation of luminosity."

ON THE CALORIFIC RELATIONS OF HYDROGEN AND OTHER GASES.

ABSTRACT OF A PAPER BY PROFESSOR MAGNUS.

(Translated from Poggendorff's Annalen. No. 2, 1861.)

"Professor Magnus communicated to the Academy of Sciences of Berlin, on the 30th of July, 1860, a series of investigations respecting the conductibility, &c., of heat in various gases; and on the 7th of February, of this year, he laid before the Academy a second series of these investigations,* the principal results of which are given below:

"1. The final temperature indicated by a thermometer placed in a vessel warmed from above, varies according to the nature of the gas with which the vessel is filled.

"2. In hydrogen this temperature becomes higher than in any other gas.

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* *Ueber die Verbreitung der Wärme in den Gasen. Pogg, Ann., Febuar*, 1861. An abstract by the Editor of the *Annalen*, of an article published by Professor Magnus (in continuation of some previous investigations on this subject) in the *Monatsberichte der Akademie der Wissenschaften zu Berlin*. An abstract of this memoir, with some additional observations by M. Verdet, is also given in the *Annales de Chimie et de Physique* for March, 1861; but in this, many of the conclusions, as given by Prof. Magnus, are omitted.—E. J. C.

"3. The temperature is also higher in this gas than in a vacuum; and the denser the gas employed, the higher the temperature.

"4. Hydrogen, therefore, conducts heat like a metal.

"5. In all other gases the final temperature, as shown by an enclosed thermometer, is lower than in a vacuum; and the denser these gases become, the lower the temperature falls.

"6. It must not be concluded from this, however, that the gases in question do not conduct heat at all; but only that their powers of conduction are so feeble, as to be unable to overcome the opposition offered by their substance to the transmission of heat.

"7. The striking conductibility of hydrogen is not only manifested when the gas is entirely free, so to say, within itself, but also when the enclosing vessel is filled with eider-down or other flocculent matters by which the free motion of the hydrogen is more or less hindered.

"8. All gases, including hydrogen, offer a certain opposition to the passage of heat-rays; and the denser the gas, the greater this opposition.

"9. Of all gases, atmospheric air, (and its constituents) offers the least opposition to the passage of heat.

"10. The transmission of heat varies according to the source from which the heat comes. The rays which proceed from boiling water exhibit the greatest variation as regards their passage through different gases.

"11. Of all colourless gases, Ammonia transmits the least heat. Next to this stands Olefiant gas.

"12. The action of rays of heat, like those of light, may be increased by the employment of a tube.

"13. The nature or condition of the inner surface of the tube affects the transmission of these rays.

"14. The character of this surface changes also the conditions under which the rays are transmitted through different gases.

"15. It follows consequently, that rays reflected from different surfaces are transmitted through gases with different degrees of facility.

"16. The rays transmitted from different sources of heat always pass through hydrogen gas with greater difficulty than through atmospheric air.

"17. The high temperature indicated by a thermometer placed in hydrogen gas into which heat is transmitted from above, does not

depend therefore on the possession, by this gas, of higher heat-transmitting powers, but solely on its greater power of conduction.

"18. This striking conductibility affords an additional proof of the analogy of hydrogen to the metals.

"19. Hydrogen also conducts electricity better than other gases.

ON THE ELECTRICITY OF THE FLAMES OF HYDROGEN AND ALCOHOL.

BY M. MATEUCCI.

(Translated from the Annales de Chimie et de Physique. Mars, 1861.)

It has been generally admitted, hitherto, that the electrical manifestations discovered by M. Pouillet in the flame of hydrogen, depend on the chemical phenomena of combustion. Subsequently to M. Pouillet's researches, I shewed the analogy which exists between these electrical phenomena and the fact that a voltaic couple may be obtained by the immersion in water of two strips of platinum, one of which has been (or is) in contact with hydrogen, and the other with oxygen.

More lately, M. Hankel has made some interesting experiments on the same subject, but these, I should observe, are only known to me by an extract given in the *Annales de Chimie*, by M. Verdet. According to the latter, the experiments of M. Hankel show clearly that the chemical reactions which take place in the flame, go for nothing in the production of the electricty observed therein. This conclusion, however, does not appear to be sufficiently proved by the experiments cited in the extract, and it is contradicted, moreover, by an apparently decisive experiment of my own, to which I now beg to recal attention. This experiment was made some time ago, but I have subsequently verified it by repetition under different conditions. It is made with a galvanometer of 24,000 coils, the ends of which consist of two platinum wires terminating in spirals. The homogeneity of the wires is secured by plunging them into distilled water. They are then suffered to dry in the air, and one is inserted into the central or obscure portion of a hydrogen (or alcohol) flame, whilst the other is placed at the point of the flame itself. A current

is immediately set up, passing from the wire in the central part of the flame, to that placed in contact with the outer envelope of this or with the atmospheric air. It is well known that gas or vapours heated to a certain temperature become conductors, and hence, there is an analogy between the conditions of this experiment and those of the one mentioned above, in which two strips of platinum are plunged into water, after having been in contact, the one with hydrogen, and the other with oxygen. This analogy appears to me to be sustained by the following experiment. After the platinum wires are removed from the flame, as described above, they are allowed to cool in the air, and are then, after the lapse of several minutes, plunged into distilled water. A current is manifested of much greater intensity than that which originates in the flame; but the direction is similar—*id est,* from the wire that was placed in the centre of the flame to that which was in contact with the flame's outer surface. This fact may be verified by changing the positions of the wires. Finally, the wires which have been thus in contact with the flame, produce no current if plunged into mercury, whilst a current is obtained immediately on plunging them into water. This experiment, I must repeat therefore, appears to me to prove the existence of a certain analogy between the electrical phenomena of flame and those of the oxy-hydrogen battery. E. J. C.

SCIENTIFIC AND LITERARY NOTES.

CANADIAN CAVERNS.—BY GEORGE D. GIBB, M.D., ETC.

Dr. Gibb has dedicated to the *Canadian Institute* an interesting memoir on Canadian Caverns, read by him before the British Association for the Advancement of Science at Aberdeen, and subsequently published in the pages of the *Geologist.* In its present garb, this memoir forms an octavo pamphlet of some thirty pages, with eight lithographed plates. The caverns described—including a few beyond the confines of the Province—are arranged in two series, as in the following tabular view :—

A.—*Caverns, Arched Rocks, etc., washed by the waters of existing seas, lakes, or rivers.*

1. Caverns on the shores of the Magdalen Islands.
2. Caverns and arched rocks at Percé, Gaspé.
3. Gothic arched recesses, Gaspé Bay.
4. The "Old Woman" or flower-pot rock at Cape Gaspé.
5. Little River caverns, Bay of Chaleur.
6. Arched and flower-pot rocks of the Mingan Islands.

7. Pillar sandstones, north coast of Gaspé.
8. Niagara caverns.
9. Flower-pot Island, Lake Huron.
10. Perforations and caverns of Mackinac, Lake Huron.
11. Pictured Rocks, Lake Superior.
12. St. Ignatius caverns, Lake Superior.
13. Pilasters of Mammelles, Lake Superior.
14. Thunder Mountain and Paté Island Pilasters, Lake Superior.

B.—*Inland Caverns and Subterranean Passages.*

15. The Steinhauer Cavern, Labrador.
16. The basaltic caverns of Henley Island.
17. Empty basaltic dykes of Mecattina Islands, off south coast of Labrador.
18. Bigsby's cavern, Murray Bay.
19. Bouchette's cavern, Kildare (north of Montreal.)
20. Gibb's cavern, Montreal.
21. Protable caverns at Chatham on the Ottawa.
22. Colquhoun's cavern, Lanark.
23. Quartz cavern, Leeds.
24. Protable caverns at Kingston.
25. Mono cavern (County of Simcoe.)
26. Eramosa cavern (County of Waterloo.)
27. Cavern in the Bass Islands, Lake Erie.
28. Subterranean passages in the Great Manitoulin Island, Lake Huron.
29. Murray's cavern and subterranean river, Ottawa.

Up to this time, neither bones nor other animal remains appear to have been met with in any of the above excavations. A strict search, however, might lead to the discovery of these remains, beneath the stalagmitic deposit with which the floor of some of the caverns, described by Dr. Gibb, is more or less thickly covered.

BAUXITE. HYDRATED SESQUIOXIDE OF IRON AND ALUMINA.

Large deposits of this peculiar compound have been announced by M. Deville as occurring in the Department of the Bouches-du-Rhône, (Commune of Beaux near Arles) and in those of the Gard and Var, in the south of France. Its occurrence in rock masses is also reported from Calabria. Analysis shews the presence (as essential components) of alumina, sesquioxide of iron, and water, although in variable proportions, the substance being rather a rock than a mineral, properly so-called. It is evidently, moreover, an altered product. Many samples are smelted as an ore of iron, yielding from 33 to 43 per cent. of cast metal. Others are employed in the *usines* of Salyndres in the preparation of alumina and aluminium. When strongly heated, it becomes converted into a crystalline corundum, resembling emery both in aspect and in physical and chemical characters. Additional observations of much interest on the geological conditions of this substance are promised by M.M. Le Chatelier and Meissonnier, to whom M. Deville was indebted for his specimens. *Annales de Chimie et de Physique, Mars,* 1861.

E. J. C.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—APRIL, 1861.

Latitude—43 deg. 39.4 min. North. Longitude—5 h. 17 min. 33 sec. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°. 6 A.M.	2 P.M.	10 P.M.	MEAN.	Temp. of the Air. 6 A.M.	2 P.M.	10 P.M.	ME'N	Excess of mean above Average	Tens. of Vapour. 6 A.M.	2 P.M.	10 P.M.	M'N
1	29.777	29.573	29.516	29.6112	32.2°	31.6°	33.1°	32.28°	— 3.95°	.118	.170	.184	.162
2	.678	.755	.817	.7568	28.7	36.0	32.4	32.85	— 3.78	.145	.144	.152	.150
3	.880	.920	30.018	.9483	26.2	37.4	29.1	32.05	— 4.97	.116	.170	.141	.148
4	30.081	30.050	29.993	30.0412	32.0	38.1	31.6	34.28	— 3.05	.166	.169	.132	.156
5	29.980	29.961	.924	29.9473	29.1	43.4	36.7	37.80	+ 0.08	.126	.125	.128	.126
6	.910	.884	.857	.8843	38.1	45.4	40.3	41.47	+ 3.43	.109	.134	.201	.151
7	.786	.769	—	—	37.1	43.2	—	—	—	.182	.217	—	—
8	.714	.675	.630	.6688	36.0	43.9	39.9	40.30	+ 1.58	.172	.235	.155	.191
9	.618	.610	.683	.6403	37.1	46.6	46.4	43.67	+ 4.63	.192	.145	.221	.183
10	.725	.758	.726	.7387	37.0	52.6	39.9	44.13	+ 4.72	.124	.130	.190	.147
11	.734	.663	.541	.6327	36.7	55.5	47.2	47.88	+ 8.15	.171	.241	.138	.201
12	.506	.447	.393	.4363	42.8	55.5	47.2	47.83	+ 7.70	.258	.315	.310	.287
13	.249	.183	.222	.2155	42.8	55.6	46.8	48.62	+ 8.18	.258	.348	.282	.301
14	.322	.453	—	—	41.0	43.2	—	—	—	.184	.155	—	—
15	.588	.639	.640	.6308	34.2	37.8	35.3	35.95	— 5.10	.177	.165	.170	.170
16	.634	.514	.388	.4918	33.1	42.8	37.8	38.50	— 2.92	.167	.143	.090	.146
17	.257	.199	.324	.2602	32.4	43.2	33.1	36.03	— 5.72	.138	.139	.130	.125
18	.247	.133	.273	.2183	30.2	33.3	32.7	32.45	— 9.62	.149	.165	.172	.158
19	.414	.486	.576	.5052	29.8	43.2	34.2	36.27	— 6.08	.147	.217	.130	.160
20	.662	.555	.554	.5865	33.8	38.2	40.3	41.30	— 1.48	.166	.216	.185	.191
21	.612	.622	—	—	37.8	52.9	—	—	—	.157	.224	—	—
22	.391	.263	.375	.3392	42.5	59.4	60.1	54.77	+11.40	.207	.276	.402	.307
23	.529	.510	.443	.4898	48.6	50.0	49.3	49.02	+ 5.32	.279	.324	.313	.304
24	.325	.297	.354	.3282	42.8	59.0	47.9	50.02	+ 6.02	.208	.357	.193	.245
25	.461	.585	.648	.5792	40.7	50.0	42.5	43.98	— 0.42	.161	.193	.190	.176
26	.723	.663	.570	.6437	36.0	47.1	42.8	43.27	— 1.43	.175	.194	.213	.194
27	.391	.229	.085	.2170	41.0	52.6	52.6	48.67	+ 3.65	.210	.290	.375	.286
28	.087	.316	—	—	46.1	52.6	—	—	—	.292	.321	—	—
29	.445	.390	.415	.4182	40.5	60.5	50.4	51.03	+ 5.30	.199	.338	.289	.266
30	.421	.430	.443	.4338	47.5	51.1	43.9	48.12	+ 2.07	.255	.269	.218	.236
M	29.5906	29.5529	29.5544	29.5640	36.61	46.92	41.29	42.02	+ 1.03	.179	.216	.204	.199

Day.	Humidity of Air. 6 A.M.	2 P.M.	10 P.M.	M'N	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Resultant Direction.	Velocity of Wind. 6 A.M.	2 P.M.	10 P.M.	Result.	ME'N	Rain in Inches.	Snow in Inches.
1	.64	.96	.98	.89	E	E b S	E	S 89° E	19.2	21.3	10.3	12.22	16.38	Inp.	6.0
2	.92	.68	.83	.81	W b S	W N W	N	N 63 W	2.5	9.0	1.0	3.20	3.75	..	...
3	.82	.76	.87	.81	N	S	S E b E	N 70 E	4.4	1.0	0.5	0.67	1.28	..	...
4	.91	.74	.74	.79	N E	E S E	Calm.	N 84 E	4.7	1.2	0.0	1.83	2.24	...	...
5	.78	.44	.59	.56	Calm.	S E b E	N	N 57 E	0.0	3.8	4.2	2.27	3.23	...	...
6	.47	.44	.80	.58	E N E	E b N	E	N 80 E	5.8	15.5	15.2	12.95	12.98	...	...
7	.83	.77	—	—	E b N	E b N	E b S	N 83 E	10.6	19.8	4.0	13.02	13.20	...	...
8	.81	.82	.62	.75	E b N	E	E b N	N 85 E	12.0	19.5	16.5	16.04	16.06	0.015	...
9	.86	.47	.70	.66	E b N	E b N	E b N	N 79 E	14.5	22.0	12.0	14.63	14.70	0.015	...
10	.56	.33	.77	.53	N E	S E b E	N b W	N 67 E	4.8	7.4	1.5	2.31	4.47	...	...
11	.78	.54	.42	.59	Calm.	E	E b N	N 87 E	0.0	9.8	13.2	7.52	7.78	0.072	...
12	.94	.71	.95	.87	E	S E	Calm	S 78 E	6.2	5.6	0.0	4.30	4.60	0.515	...
13	.94	.79	.89	.88	E N E	S S E	W S W	S 77 W	2.8	4.6	1.6	3.09	5.78	Inp.	...
14	.71	.54	—	—	W b N	W b N	W b N	N 76 W	12.8	22.2	7.0	13.56	13.79	...	...
15	.89	.72	.83	.80	Calm.	S S E	Calm.	N 42 E	0.0	4.2	0.0	1.38	2.88	...	Inp.
16	.88	.51	.38	.62	N N E	N E	N E b N	N 32 E	6.2	11.6	17.0	12.54	13.57	...	...
17	.75	.48	.69	.60	N N W	N W b N	W b N	N 38 W	16.4	25.5	13.0	15.99	16.76	...	...
18	.89	.86	.92	.86	Calm	E N E	N E b N	N 21 E	0.0	8.2	1.0	4.54	5.40	...	0.7
19	.88	.77	.66	.74	N N W	N W b N	W N W	N 34 W	9.5	14.5	9.0	12.12	12.33	..	...
20	.85	.64	.73	.72	Calm.	S W b S	S W	S 52 W	0.0	18.0	2.3	6.63	7.40	...	...
21	.69	.56	—	—	N b W	E S E	E N E	E	3.4	6.5	9.0	5.96	7.68	0.025	...
22	.76	.54	.77	.70	E N E	S S E	N W b W	S 79 W	10.0	6.5	9.0	2.32	8.63	0.005	...
23	.81	.89	.88	.87	N N W	S W b S	E b N	N 68 E	6.8	0.8	8.0	2.10	4.32	0.037	...
24	.98	.71	.57	.71	E S E	S W b S	S W b W	S 63 W	3.2	21.6	9.4	11.99	13.10	0.005	...
25	.63	.53	.69	.61	W b N	W b N	N W	N 69 W	17.0	17.0	5.5	10.19	10.83	...	...
26	.83	.59	.77	.69	N	E S E	E	S 89 E	2.0	9.8	11.0	9.19	9.50	...	...
27	.81	.73	.94	.82	E b N	E	N E b E	N 82 E	7.5	8.4	6.5	6.12	9.21	0.615	...
28	.94	.80	—	—	W	W N W	S E b E	N 52 W	26.6	15.0	0.8	10.13	11.62	...	...
29	.79	.64	.78	.70	E b N	S W	S W b W	S 40 W	1.5	10.7	1.5	3.41	5.56	...	...
30	.77	.71	.75	.70	W b S	W b N	W b N	N 39 W	5.0	8.0	3.2	5.28	8.08	0.515	0.2
M	.81	.65	.75	.73	....	....	....	....	7.18	11.63	6.44	......	8.90	1.619	6.9

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR APRIL, 1861.

Highest Barometer .... 30.120 at 8 a. m. on 4th } Monthly range=
Lowest Barometer .... 29.055 at midn't on 27th } 1.065 inches.

Self-regist'ing Thermom.:
- Maximum Temperature .... 67°0 on p.m. of 22nd } Monthly range=
- Minimum Temperature .... 23°8 on a.m. of 3rd } 43°2
- Mean maximum Temperature .... 40°71 } Mean daily range=
- Mean minimum Temperature .... 35°35 } 14°36
- Greatest daily range .... 28°8 from a. m. to p. m. of 29th.
- Least daily range.................. 2°5 from a. m. to p. m. of 14th.

Warmest day......... 22nd... Mean temperature......... 54.77 } Difference = 22°72.
Coldest day............ 3rd... Mean temperature......... 32°05 }
Maximum { Solar................................. 81°8 on p. m. of 13th } Monthly range =
Radiation. { Terrestrial.......................... 15°9 on a. m. of 3rd } 65°9
Aurora observed on 5 nights, viz.: 2nd, 4th, 8th, 9th, and 15th.
Possible to see Aurora on 17 nights; impossible on 13 nights.
Snowing on 4 days; depth 6.9 inches; duration of fall 22.0 hours.
Raining on 12 days,—depth 1.619 inches; duration of fall 29.3 hours.
Mean of cloudiness = 0.61. Above average 0.03.
Most cloudy hour observed, 6 a. m., mean = 0.67; least cloudy hour observed, 10 p.m., mean, 0.54.

Sums of the components of the Atmospheric Current, expressed in miles.

North.	South.	East.	West.
2029.31	708.36	3088.56	2082.41

Resultant direction N. 37° E.; Resultant velocity 2.31 miles per hour.
Mean velocity.......................... 8.90 miles per hour.
Maximum velocity .... 33.0 miles, from 5 to 6 a. m. on 28th.
Most windy day ....17th......... Mean velocity, 16.76 miles per hour. } Difference =
Least windy day......... 3rd......... Mean velocity 1.28 ditto. } 15.48 miles.
Most windy hour ...... 3 to 4 p.m.............Mean velocity 12.31 ditto. } Difference =
Least windy hour...... 9 to 10 p.m.............Mean velocity 6.35 ditto. } 5.96 miles.

1st. Very stormy day; snowing and drifting from 8 a. m. to 10 p. m.
4th. Solar halo during the forenoon
5th. Solar halo at 2 p. m. 6th. Solar halo at 2 and 4 p. m.
12th. Frogs croaking at night, (first heard this season).
13th. Foggy at 6 and 8 a. m.; wild pigeons numerous.
18th. Slight snow from 10 a. m. to 8 p. m. Cold day.
19th. Solar halo from 9 a. m. to 2 p. m.
21st. Lunar halo at 8 p. m.
22nd. Thunderstorm, lightning, and rain, 7 to 9 p. m.
23rd. Thunderstorm, lightning, and rain, 9 p. m. to midnight.
24th. Dense fog, 6 and 8 a. m., and imperfect rainbow at 5.30 p.m.
25th. Solar halo at 6 a. m.; lunar corona at midnight.
26th. Solar halo at 1 and 2 p. m.
27th. Thunderstorm, lightning, and rain, 7 to 9 p. m.
30th. Thunderstorm, lightning, and rain, 1.20 to 3.20 p. m.

The Resultant Direction and Velocity of the Wind for the month of April, from 1848 to 1861 inclusive, were respectively N. 19 W. and 2.04 miles.

COMPARATIVE TABLE FOR APRIL.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	No. of days.	Inch's.	No. of days.	Inch's.	Resultant Direction.	Resultant V'y.	Mean Force or Velocity.
	°	°	°	°	°							
1840	42.4	+1.4	65.9	25.3	40.6	14	3.420	2	...	...	...	....
1841	39.2	—1.8	62.9	22.1	40.8	3	1.370	3	...	...	...	0.51 lbs.
1842	43.1	+2.1	89.5	21.6	67.9	8	3.740	2	...	...	...	0.57
1843	40.9	—0.1	70.0	15.1	54.9	7	3.185	3	0.1	...	...	0.46
1844	47.5	+6.5	74.5	17.2	57.3	10	1.515	1	Inap.	...	...	0.24
1845	42.1	+1.1	66.0	14.8	51.2	11	3.290	4	1.5	...	...	1.00
1846	44.0	+3.0	79.4	24.4	55.0	10	1.300	2	1.3	...	...	0.55
1847	39 2	—1.8	65.6	8.4	57.2	8	2.870	2	4.0	...	...	0.59
1848	41.3	+0.3	65.4	26.5	38.9	5	1.455	1	0.5	N 77° W	1.46	4.89 mls.
1849	39.0	—2.0	70.9	23.2	47.7	10	2.655	2	1.7	N 43° W	3.14	7.50
1850	37.9	—3.1	63.2	18.2	45.0	7	4.720	2	1.1	N 39° W	1.12	7.64
1851	41.3	+0.3	59.2	25.8	33.4	11	2.295	3	1.2	N 14° E	2.52	8.07
1852	38.2	—2.8	53.8	19.8	34.0	6	1.990	4	9.4	N 23° E	2.44	6.68
1853	41.9	+0.9	65.7	27.0	38 7	10	2.625	1	1.0	N 12° W	1.95	5.20
1854	41.0	0.0	65.1	22.3	42.8	12	2.685	4	2.7	N 50° E	2.57	6.81
1855	42.4	+1.4	63.8	12.2	51 6	8	2.030	3	1.6	N 36° W	3.99	7.57
1856	42.3	+1.3	69.8	15.1	54.7	13	2.780	3	0.1	N 29° E	1.64	6.05
1857	35.4	—5.6	51.9	10.0	41.9	10	1.755	11	12.9	N 60° W	4.15	10.24
1858	41.5	+0.5	61.5	23.8	37.7	13	1.642	2	0.1	N 14° W	1.64	9.57
1859	39.5	—1.5	62.1	23.9	38.2	9	2.527	8	1.2	N 36° W	2.33	10.79
1860	39.5	—1.5	60.7	19.7	41.0	11	1.282	5	0.3	N 37° W	4.10	10.30
1861	42.0	+1.0	62.3	26.2	36.1	12	1.619	4	6.9	N 37° E	2.31	8.90
M	40.98	...	65.87	20.12	45.75	9.5	2.398	3.3	2.51	....	...	7.87 Ml.
Diff. from av'g.	+ 1.04	...	— 3.57	+ 6.08	— 9.65	+ 2.5	— 0.779	+ 0.7	+ 4.39	....	...	+ 1.03

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—MAY, 1861.

Latitude—43 deg. 39.4 min. North. Longitude—5 h. 17 m. 33 s. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°. 6 A.M.	2 P.M.	10 P.M.	Mean.	Temp. of the Air. 6 A.M.	2 P.M.	10 P.M.	ME'N	Excess of mean above Average	Tens. of Vapour. 6 A.M.	2 P.M.	10 P.M.	M'N	Humidity of Air. 6 A.M.	2 P.M.	10 P.M.	M'N	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Resul't. Direction.	Velocity of Wind. 6 A.M.	2 P.M.	10 P.M.	Result'.	ME'N	Rain in inches.	Snow in inches.
					°	°	°	°	°												°							
1	29.466	29.690	29.813	29.6682	32.7	39.2	33.1	34.93	—11.48	.180	.147	.108	.143	.97	.61	.56	.70	N b W	N W	NW b N	N 37 W	23.5	29.5	19.0	21.32	21.62	...	0.5
2	.870	.821	.766	.8167	29.1	42.8	33.1	36.03	—10.68	.141	.195	.130	.146	.87	.71	.69	.69	NW b N	NW b W	Calm.	N 43 W	13.5	11.6	0.0	5.20	7.23	...	...
3	.721	.631	.625	6610	34.2	44.3	34.2	37.72	— 9.33	.131	.106	.131	.125	.66	.36	.66	.56	N b E	E b S	N E	N 70 E	2.5	9.0	4.0	5.27	6.32	...	...
4	.789	.671	.623	.6523	37.4	48.6	38.8	42.57	— 4.85	.110	.137	.160	.136	.48	.40	.68	.51	N b E	S S W	N W	S 37 W	3.2	8.2	1.6	1.44	4.44	...	...
5	.616	.440	—	—	40.3	51.8	—	—	—	.158	.181	—	—	.63	.45	—	—	N b E	E b N	E	N 89 E	2.0	13.2	10.0	11.33	11.46	0.260	...
6	.234	.056	28.644	28.9728	45.0	51.[illegible]	47.9	47.75	— 0.28	.269	.309	.311	.294	.90	.82	.93	.89	E b S	N E b E	NW b N	N 22 E	6.5	11.5	25.5	4.04	15.96	1.845	...
7	28.706	28.819	28.994	28.8720	49.0	52.7	48.4	49.52	+ 1.10	.257	.278	.270	.265	.74	.70	.85	.75	W b S	W S W	W S W	S 76 W	18.0	23.0	10.6	14.99	15.53	0.100	...
8	29.106	29.317	29.485	29.3225	40.7	49.0	42.5	44.17	— 4.62	.205	.206	.218	.206	.80	.59	.80	.72	NW b N	NW b N	N	N 40 W	11.8	14.5	4.2	8.74	9.06	Inp.	...
9	574	.696	.573	.5850	38.5	52.6	43.2	44.93	— 4.23	.199	.209	.209	.224	.84	.67	.74	.74	Calm.	S	Calm.	S 26 E	0.0	4.0	0.0	2.08	2.59	...	...
10	.510	.302	.301	.3088	41.7	47.2	45.7	45.05	— 4.38	.200	.203	.288	.231	.76	.61	.94	.76	N E b E	E b N	N E b E	N 69 E	5.4	15.2	5.6	6.71	7.17	0.165	...
11	.355	.424	.465	.4158	46.4	54.4	46.1	48.58	— 1.32	.249	.298	.273	.270	.79	.69	.87	.79	N N E	S S E	Calm.	S 43 W	3.0	4.8	0.0	0.69	2.92	...	...
12	.523	.552	—	—	47.9	60.1	—	—	—	.208	.209	—	—	.81	.57	—	—	Calm.	S E b E	Calm.	S 61 E	0.0	1.8	0.0	1.70	3.07	...	...
13	.522	.396	.303	.3910	48.6	46.4	46.8	47.82	— 2.75	.279	.288	.302	.296	.81	.91	.94	.89	E N E	E b N	Calm.	N 82 E	3.6	14.4	0.0	7.07	7.51	0.020	...
14	.289	.384	.518	.4073	45.3	54.7	50.8	50.45	— 0.43	.284	.251	.230	.259	.94	.59	.62	.71	S W	W b S	W	S 79 W	5.2	22.5	9.5	11.09	11.27	...	...
15	.572	.425	.406	.4573	44.6	54.4	44.3	48.90	— 2.35	.235	.252	.258	.246	.80	.59	.89	.73	Calm.	S E b E	W	S 62 W	0.0	9.0	11.0	3.72	7.16	0.170	...
16	.433	.538	.647	.5480	42.5	40.3	40.7	44.33	— 7.25	.227	.194	.223	.210	.83	.54	.87	.73	W	W b N	W b N	N 75 W	2.2	21.5	8.6	15.00	15.15	...	...
17	.706	.761	.847	.7747	40.7	48.2	38.9	42.28	— 9.70	.188	.179	.134	.162	.73	.52	.57	.60	NW b W	NW b N	NW b N	N 37 W	14.0	19.5	8.5	14.25	14.65	...	...
18	.877	.872	.862	.8725	35.2	50.0	42.8	44.13	— 8.15	.164	.261	.168	.208	.80	.72	.61	.71	N W	S	S E b E	N 86 W	10.6	9.3	2.0	1.22	6.41	...	...
19	.825	.714	—	—	41.0	47.5	—	—	—	.173	.170	—	—	.67	.50	—	—	N N E	N E b E	N E b N	N 52 E	5.9	10.0	5.0	7.24	7.54	Inp.	...
20	.576	.559	607	.5775	46.4	54.4	49.0	50.53	— 2.48	.221	.256	.274	.252	.70	.60	.79	.69	N E b N	S E b S	N	N 51 E	10.0	6.6	4.5	3.64	7.91	...	...
21	.661	.681	.725	.6940	47.1	60.1	48.8	52.70	— 0.62	.241	.152	.116	.188	.74	.29	.33	.48	N	N N W	N N W	N 22 W	13.0	16.6	15.0	11.65	11.83	...	...
22	.804	.806	.802	.8103	45.4	60.9	48.6	52.45	— 1.25	.225	.276	.193	.236	.74	.51	.55	.59	N N W	S b W	S b W	S 54 W	5.4	9.0	1.5	1.14	2.47	...	...
23	.849	.802	.712	.7792	42.1	56.9	51.1	50.90	— 3.07	.213	.253	.309	.249	.79	.54	.82	.67	Calm.	S E b E	E b S	S 77 E	0.0	6.5	4.0	4.10	4.44	...	...
24	.624	.455	.422	4068	50.0	63.0	54.4	56.82	+ 2.53	.274	.322	.308	.318	.75	.55	.72	.68	E	S S W	S S W	S 47 W	3.0	15.0	1.6	6.40	8.98	0.625	...
25	.401	.385	.409	.3893	56.9	72.0	58.0	62.25	+ 7.57	.408	.515	.343	419	.88	.65	.71	.74	W N W	NW b W	W N W	N 60 W	7.2	17.0	5.5	10.78	11.08	...	...
26	.372	.245	—	—	52.9	61.9	—	—	—	.290	.351	—	—	.74	.64	—	—	NW b W	S b W	E b N	N 87 E	12.0	3.6	8.5	1.79	7.10	0.115	...
27	28.746	.080	.347	.0860	40.0	50.0	42.1	47.33	— 7.95	.326	.214	.213	.251	.94	.59	.79	.76	N N E	W N W	NW b W	N 61 W	4.0	37.9	28.5	27.39	27.96	Inp.	...
28	29.463	.531	.615	.5527	42.6	60.1	44.6	48.00	— 7.65	.164	.181	.217	.197	.59	.34	.74	.60	NW b W	W b N	NW b N	N 45 W	20.0	10.6	7.0	10.28	11.50	0.080	...
29	.717	.754	.844	.7767	42.8	52.2	42.1	45.82	—10.13	.223	.244	.178	.215	.81	.62	.66	.69	N W	N W	NW b W	N 47 W	8.8	9.0	1.0	4.81	6.07	...	...
30	.930	.909	.888	.9095	40.3	60.1	50.8	51.62	— 4.63	.158	.287	.230	.233	.63	.54	.62	.60	Calm.	S S W	W	S 33 W	0.0	8.0	3.2	4.22	4.64	...	...
31	.942	.874	.809	.8684	49.0	63.7	48.6	54.80	— 1.75	.235	.278	.260	.286	.67	.47	.79	.67	N	E b S	N E b E	S 73 E	1.4	5.0	1.7	2.52	3.12	...	...
M	29.5548	29.5580	29.5575	29.5454	43.08	53.27	44.94	47.50	— 3.94	.228	.248	.235	.232	.78	.58	.73	.69	....	....	....	....	6.06	12.81	6.68	....	9.17	3.380	0.5

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR MAY, 1861.

Highest Barometer . . . . 29.955 at 8 a. m. on 30th. } Monthly range=
Lowest Barometer . . . . 28.644 at 10 p. m. on 6th. } 1.311 inches.

Self-registering Ther.:
Maximum temperature . . . . 73°0 on p.m. of 25th } Monthly range=
Minimum temperature . . . . 28°0 on a.m. of 2nd } 45°0
Mean maximum temperature . . 55°69 } Mean daily range=15°65.
Mean minimum temperature . . 40°04 }
Greatest daily range . . . . . . 28°4 from a. m. to p.m. on 30th.
Least daily range . . . . 5.0 from a. m. to p. m. on 13th.

Warmest day . . 25th ... Mean Temperature . . .=62°25 } Difference=27°32.
Coldest day . . . 1st ... Mean Temperature . . .=34°93 }

Maximum { Solar . . . . 88°0 on p.m of 25th } Monthly range=
Radiation { Terrestrial . . . . . . 22.0 on a. m. of 2nd } 66°0.

Aurora observed on 5 nights, viz: 4th, 8th, 15th, 16th, and 17th; possible to see Aurora on 18 nights; impossible on 13 nights.
Snowing on 1 day: depth, 0.5 inches; duration of fall, 1.0 hours.
Raining on 12 days; depth, 3.380 inches; duration of fall, 47.9 hours.
Mean of cloudiness=0.49, below average 0.04; most cloudy hour observed 8 a. m., mean =0.56; least cloudy hour observed 10 p. m., mean=0.36.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
2789.34	962.51	1507.67	3471.05

Resultant direction, N 47° W; Resultant Velocity, 3.60 miles per hour.
Mean velocity 9.17 miles per hour.
Maximum velocity . . . 43.6 miles, from noon to 1 p.m. on the 27th.
Most windy day . . 27th—Mean velocity 27.96 miles per hour. } Difference
Least windy day . . 22nd—Mean velocity, 2.47 do } 25.49 miles.
Most windy hour, 11 a.m. to noon.—Mean velocity, 13.36 miles per hour. } Difference
Least windy hour, 4 to 5 a. m.—Mean velocity, 5.07 do. } 8.29 miles.

1st. Snowing and sleeting till 7 a.m.; cold, stormy day.—2nd. Ice 0.5 inch thick at 6 a.m.; cold day.—3rd. Thin ice at 6 a.m.; cold day.—4th. Ice ¼ inch thick at 6 a.m.—10th. Solar halo during the forenoon.—Dense fog at 10 p.m. and midnight.—14th. Dense fog and heavy dew at 6 a.m.—15th. Distant thunder, p.m.; perfect rainbow at 7 p.m.—17th. Lunar halo at 10 p.m. and midnight.—18th. Lunar halo at 10 p.m.—23rd. Lunar halo at 10 p.m.—24th. Severe thunderstorm from 10 p.m. to 3 a.m. of 25th.—26th. Thunderstorm, vivid lightning, and moderate rain from 6 to 8 a.m.

Hoar frost recorded on 5 mornings during the month.
Heavy dew observed on 6 mornings during the month.

The barometric reading at 10 p.m. on the 6th, was the lowest noted in any May during the last 22 years.
The 27th was the most windy day in May during the last 14 years.
The Resultant Direction and Velocity of the Wind for the month of May, from 1848 to 1861 inclusive, were respectively N. 2° W., and 1.49 miles.
May, 1861, was the coldest since the establishment of this Observatory.

COMPARATIVE TABLE FOR MAY.

YEAR.	TEMPERATURE. Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	RAIN. No. of days.	Inches.	SNOW. No. of days.	Inches.	WIND. Resultant Direction.	Resultant Velocity.	Mean Velocity
	°		°	°	°					°		
1840	53.8	+ 2.4	74.5	30.8	43.7	9	4.150	0	...	...	...	...
1841	50.5	— 0.9	76.2	26.6	49.6	11	2.350	1	...	...	...	0.35lbs
1842	49.1	— 2.3	74 3	30.0	44.3	7	1.275	0	...	...	...	0.53 "
1843	49.1	— 2.3	79.6	28.9	50.7	5	1.570	0	0.0	...	...	0.52 "
1844	53.6	+ 2.2	77.7	29.0	48.7	14	5.670	0	0.0	...	...	0.30 "
1845	49.6	— 1.8	76.6	29.4	47.2	8	2.300	0	0.0	...	...	0.55 "
1846	55.5	+ 4.1	78.1	34.3	43.8	9	4.375	0	0.0	...	...	0.46 "
1847	54.4	+ 3.0	72.5	27.8	44.7	12	2.040	0	0.0	...	...	0.29 "
1848	54.1	+ 2.7	78.5	31.9	46.6	13	2.520	0	0.0	N 40 W	1.31	4.93ms.
1849	48.0	— 3.4	72.5	32.7	39.8	16	5.115	0	0.0	N 51 E	1.97	5.33 "
1850	47.6	— 3.8	76.3	31.1	45.2	7	0.545	1	inap.	N 64 W	2.05	6.32 "
1851	51.3	— 0.1	73.2	28.7	44.5	12	2.950	1	0.5	N 32 W	1.59	6.34 "
1852	51 4	0.0	73.3	34.5	38.8	7	1.125	1	inap.	S 82 W	0.99	4.00 "
1853	50.9	— 0.5	78.4	38.4	40.0	17	4.420	1	inap.	N 2 W	0.83	5.16 "
1854	52.2	+ 0.8	69.0	27.6	41.4	11	4.630	0	0.0	E	0.40	5.38 "
1855	53.1	+ 1.7	74.8	33.9	40.9	6	2.565	2	0.9	N 1 W	2.76	5.93 "
1856	50.5	— 0.9	80.1	35.5	44.6	14	4.580	1	inap.	N 4 E	3.99	9.81 "
1857	48.9	— 2.5	72.5	27.9	44.6	15	4.145	1	inap.	N 23 W	1.14	8.13 "
1858	48.9	— 2.5	66 0	35.0	31.0	17	6.367	0	0.0	N 42 E	3.33	9.30 "
1859	55.2	+ 3.8	76.2	41.5	34.7	11	3.410	0	0.0	N 72 E	1.59	5.70 "
1860	55.5	+ 4.1	73.2	35.6	37.6	16	1.815	0	0.0	N 26 E	2.66	7.17 "
1861	47.5	— 3.9	72.0	29.1	42.9	12	3.380	1	0.5	N 47 W	3.60	9.17 "
Mean	51.39	...	74.80	31.83	42.97	11.3	3.241	0.5	0.10	...	...	6.62
Diff. from Av'ge.	—3.89	...	—2.80	—2.73	—0.07	+ 0.7	+ 0.139	+ 0.5	+ 0.40	...	...	+ 2.55

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—APRIL, 1861.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.—F.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Horizontal Movement in Miles in 24 hours.	Mean of Ozone. (tenths)	Rain in Inches.	Snow in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M	6 A.M	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.					6 A.M.	2 P.M.	10 P.M.
1	30.508	30.288	30.200	10.4	29.2	26.1	.048	.123	.105	.69	.77	.75	N E b E	N E b E	N E b E	225.40	3.0	...	...	Clear.	Cu. Str. 10.	Cirr. Str. 10.S.
2	162	159	220	26.2	34.0	26.1	.111	.170	.105	.86	.80	.80	N E b E	N E b E	N E b E	224.70	5.0	...	7.23	Snow.	Snow.	Snow.
3	246	319	347	25.1	38.2	27.1	.117	.185	.111	.87	.80	.75	N E b E	N E b E	W N W	52.80	3.0	...	1.10	Cu. Str. 10.	C. C. Str. 6.	Clear. Z. l., b.
4	280	108	212	15.4	53.4	31.9	.065	.321	.147	.74	.80	.80	S W	W S W	W S W	2.60	2.0	...	...	Clear.	Clear.	Do.
5	190	173	347	23.7	57.6	33.4	.100	.236	.162	.79	.53	.84	N E	S S W	N W b W	61.00	2.0	...	...	Do.	Do.	Do. ft. A.B.
6	260	387	332	27.1	56.1	33.2	.111	.282	.162	.75	.63	.86	S E b E	S E b E	S W	81.40	1.0	...	...	Do.	Do.	Do.
7	257	202	329	24.1	50.3	31.0	.105	.186	.110	.75	51	.64	S b W	W S W	W b N	85.10	2.0	...	...	Do.	Do.	Do. A. B.
8	247	381	300	21.1	42.9	30.0	.080	.092	.136	.71	.34	.83	N E b E	N E b E	N E b E	113.80	1.0	...	...	Do.	Do.	Do.
9	124	107	039	20.8	47.4	18.5	.069	.225	.180	.63	.70	.77	N E b E	N E b E	N E b E	59.80	1.0	...	...	Do.	Do.	Do. ft. A.B.
10	007	29.945	29.957	20.2	61.0	42.0	.089	.413	.162	.72	.77	.61	N	N	S S W	0.10	1.0	...	...	Do.	Do.	Str. 2. Au. St.
11	008	30.006	30.101	30.0	54.6	36.5	.130	.231	.170	.78	.55	.80	N E b E	E S E	N E b E	85.30	2.0	...	...	Do.	Do.	Clear. ft. A. B.
12	020	29.920	29.874	27.2	52.8	45.0	.111	.276	.251	.25	.70	.84	N E b E	S b E	S S E	98.90	3.5	In'p.	...	Cu. Str. 2.	C. C. Str. 10.	Cirr. Str. 10.
13	29.714	474	511	42.1	52.1	44.6	.244	.361	.265	.91	.93	.91	S E b E	S E b E	S S W	88.50	4.5	0.831	...	Rain.	Rain.	Fog.
14	397	411	647	40.3	47.6	36.7	.241	.249	.184	.96	.77	.85	S E b E	S E b E	W S W	151.20	3.5	In'p.	...	Fog.	Cu. Str. 10.	Cirr. Str. 10.
15	747	740	914	31.6	40.9	32.4	.149	.145	.143	.84	.60	.79	W b S	W S W	W S W	209.80	2.0	...	...	C. C. Str. 10.	Do. 3.	Clear. Au. B.
16	934	879	790	26.9	40.3	33.3	.093	.145	.162	.64	.60	.84	N E b E	N E b E	N E b E	134.00	2.5	...	...	Clear.	Cu. Str. 10.	Cu. Str. 10.
17	245	247	127	30.4	34.2	32.7	.130	.175	.156	.78	.89	.85	N E b E	N E b E	N W b N	540.80	4.0	...	3.35	Snow.	Snow.	C. C. Str. 8.
18	364	531	467	26.4	40.1	35.0	.105	.208	.162	.78	.82	.80	W S W	S W	S W	174.70	2.0	...	...	Clear.	C. C. Str. 4.	Do. 4.
19	550	642	739	33.4	45.8	32.9	.144	.204	.137	.78	.68	.74	N N W	W S W	W S W	28.40	3.0	...	...	Do.	Do. 10.	Clear.
20	814	900	801	31.7	52.1	39.2	.130	.251	.195	.74	.63	.82	W b S	W S W	W S W	29.70	3.0	...	...	C. C. Str. 8.	Clear.	Cu. Str. 10.
21	779	879	931	35.4	51.7	41.2	.162	.252	.197	.80	.68	.79	W S W	W N W	W S W	132.90	2.0	...	...	Clear.	Clear. S'r H.	Str. 2.
22	871	771	731	38.2	42.2	43.0	.206	.206	.261	.90	.78	.96	E b N	N E b E	N E b E	49.20	3.5	0.120	...	C. Str. 10.	Cu. Str. 10.	Rain.
23	741	791	879	41.9	53.0	46.7	.228	.355	.286	.87	.84	.92	S E	S W	E N E	46.40	4.0	0.014	...	Do. 10.	C. C. Str. 10.	C. C. Str. 6.
24	687	601	647	40.0	46.6	44.2	.210	.280	.225	.89	.88	.80	N E b E	N E b E	S	75.40	3.5	0.160	...	Rain.	Rain.	Cirr. Str. 10.
25	517	674	967	40.1	48.2	41.0	.215	.242	.212	.91	.74	.82	W S W	W	W b N	229.80	2.0	...	...	Clear.	Cu. Str. 4.	Do. 8.
26	900	924	30.000	40.1	58.2	44.1	.203	.309	.265	.82	.64	.92	W b N	W b N	S S W	92.20	1.5	...	...	C. C. Str. 6.	Clear.	Str. 2.
27	900	742	29.667	35.7	58.7	39.2	.138	.372	.195	.76	.78	.82	N E b E	N E b E	N E b E	181.50	3.0	...	...	Do. 8.	Cu. Str. 9.	Cu. Str. 9.
28	412	394	514	38.4	55.0	46.3	.165	.355	.305	.72	.84	.96	N E b E	E S E	S	227.60	3.5	0.836	...	Do. 4.	Rain.	Rain.
29	711	700	710	43.0	65.7	52.0	.215	.396	.308	.79	.65	.79	W	S	S S E	43.70	3.0	0.250	...	Do. 8.	Clear.	Clear. Ct. vis.
30	747	640	689	43.0	49.0	45.4	.254	.303	.209	.92	.89	.88	N b W	E S E	W N W	50.60	3.5	0.710	...	Do. 10.	Rain.	Rain.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—MAY, 1861.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M.D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.—F.			Tension of Vapour.			Humidity of Air.			Direction of Wind.			Horizontal Movement in Miles in 24 hours.	Mean of Ozone. t'nths	Rain in inches	Snow in inches.	WEATHER, &c. A Cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A. M.	2 P. M.	10 P. M.	6 A. M.	2 P. M.	10 P. M.	6 A. M.	2 P. M.	10 P. M.	6 A. M.	2 P. M.	10 P. M.	6 A. M.	2 P. M.	10 P. M.					6 A. M.	2 P. M.	10 P. M.
1	29.651	29.752	29.950	35.3	46.0	33.0	.149	.192	.131	.74	.62	.70	N N W	N W	N W	205 40	2.5	Inap.	...	Clear.	Clear.	Clear. Frost.
2	937	897	923	24.2	42.9	33.0	096	171	156	73	62	85	W N W	W S W	W	223.60	1.0	...	...	Do. Frost.	Do.	Do.
3	979	920	900	29.0	46.7	39.9	128	208	180	77	66	77	N b W	S S W	S S W	100.50	2.0	...	...	Do.	Do.	Do.
4	902	907	910	30.1	52.4	44.7	156	282	234	85	73	80	S b E	S S E	S S E	60.30	1.5	...	...	Do.	Do.	Do. ft. Au. B.
5	897	729	914	39.1	67.0	50.8	180	470	258	77	73	71	S W	S	S	154.00	1.5	...	...	Do.	Do.	Do.
6	716	576	482	39.0	60.0	48.1	180	433	291	77	85	80	N N E	E b S	E N E	138.90	2.0	...	...	Cu. Str. 4.	C. C. Str. 6.	Rain.
7	28.900	174	160	50.9	55.1	49.1	283	375	322	78	63	92	S b W	S W	S W	437.40	3.5	2.242	...	Do. 6.	Do. 10.	Cirr. Str. 10.
8	29.263	380	480	47.0	57.0	48.3	280	208	200	88	69	78	W S W	S S W	N W	284.10	3.5	0.016	...	C. C. Str. 6.	Cu. St. 6.	Do. 10.
9	671	714	766	44.4	60.0	50.0	218	261	265	76	51	75	W b N	S W	S W	105.00	1.0	...	...	Do. 8.	Do. 6.	Do. 8.
10	770	714	591	45.2	65.9	52.1	234	265	264	80	42	69	S S W	S E	E S E	114.50	1.0	...	...	Clear.	Clear.	Clear.
11	554	689	689	46.0	65.9	56.0	221	359	336	72	58	75	N E b E	S S E	S S W	53.70	2.5	...	...	C. C. Str. 8.	C. C. Str. 10.	C. C. Str. 9.
12	698	750	839	54.0	63.7	55.0	277	392	349	75	69	81	N E b E	N E b E	S S W	29.70	3.0	0.160	...	Rain.	Cirr. 4. S'r H.	Clear.
13	853	708	642	45.1	67.9	54.2	251	362	362	84	55	87	N E b E	S E	S S E	178.70	2.5	Inap.	...	Clear.	C. C. Str. 8.	Cu. Str. 8.
14	556	520	503	51.0	58.1	53.7	348	469	269	95	94	90	S S E	S S W	S W	230.90	3.0	0.820	...	Rain.	Rain.	Do. 10.
15	643	679	701	47.5	58.0	53.2	291	265	321	89	76	80	W b S	S S W	S S E	0.30	2.0	...	...	Cu. St. 10.	Clear.	Clear.
16	509	478	618	48.8	58.4	48.5	302	337	285	82	70	85	S S W	W S W	S S W	232.40	2.0	0.262	...	Rain.	C. C. Str. 4.	Cu. Str. 8.
17	659	748	929	39.8	51.7	50.0	201	302	272	86	32	78	W S W	W	W N W	551.00	3.0	0.100	...	Do.	Cu. Str. 9.	Do. 4.
18	896	946	30.010	44.1	51.3	48.3	224	252	285	79	68	85	W	W b N	N N W	250.70	2.5	Inap.	...	Cu. Str. 10.	C.C.Str.6.S.H.	Do. 9.
19	30.009	980	29.904	43.1	68.7	52.5	245	509	264	92	75	69	W	S S W	S W	90.70	2.0	...	...	Clear.	Do. 4.	Do. 8.
20	29.857	820	862	44.3	64.2	51.8	248	285	296	88	48	79	S W	N N E	N N E	59.40	2.0	...	...	Do.	Do. 8.	Do. 4.
21	902	857	882	48 6	58.1	52.2	235	365	334	85	76	86	N b E	S W	W S W	145.80	2.5	Inap.	...	Cirr. 8.	Cu. Str. 10.	Clear.
22	950	990	960	45.0	67.0	56.2	251	340	315	84	52	71	N E b E	W N W	W b S	67.80	2.5	...	...	Do. 4.	Clear.	Do.
23	30.102	30.100	30.026	51.0	77.1	61.2	277	492	413	75	53	77	W	W S W	S W	60.70	2.0	...	...	Clear.	Do.	C. C. Str. 9.
24	29.970	29.821	29.757	55.3	72.0	61.0	349	489	433	81	62	85	W S W	S S E	S S E	184.20	2.5	Inap.	...	Do.	Cu. Str. 10.	Cu Str. 4.
25	505	476	537	54.2	70.2	60.8	390	516	338	93	70	65	S S E	S W	S W	93.90	3.5	0.360	...	Cu. Str. 10.	C. C. Str. 4.	Do. 4.
29	524	500	405	60.0	74.2	60.3	396	442	403	76	55	79	W S W	W	S S W	47.40	2.0	...	...	C. C. Str. 4.	Do. 4.	Do. 4.
27	122	28.883	28.938	54.4	56.0	49.5	383	427	315	90	97	89	S S E	N E b E	S S W	152.30	3.5	2.986	...	Rain.	Rain.	Showers.
28	256	29.432	29.654	46.0	57.0	44.2	265	413	282	92	90	98	S W	W N W	W	230.30	5.0	1.360	...	Do.	Do.	Do.
29	744	739	909	46.7	55.0	49.0	305	390	285	96	93	85	W	W N W	W	221.70	4.0	0.436	...	Cu. Str, 10.	Cirr. Str. 4.	Clear.
30	30.006	963	30.155	46.1	71.0	57.2	269	378	302	88	51	66	W	W S W	W S W	237.00	2.0	...	...	Cirr. 4.	Clear.	Do.
31	2—32	30.102	027	51.0	68.9	48.2	258	536	242	71	77	74	W S W	W S W	S W	242.20	2.0	...	...	Clear.	Do.	Do.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR APRIL.

Barometer	Highest, the 1st day	30.508
	Lowest, the 17th day	29.127
	Monthly Mean	29.888
	Monthly Range	1.381
Thermometer	Highest, the 29th day	65°.7
	Lowest, the 1st day	10°.4
	Monthly Mean	38°.90
	Monthly Range	55°.3
Greatest Intensity of the Sun's Rays		77°.3
Lowest Point of Terrestrial Radiation		9°.1
Mean of Humidity		.790

Rain fell on 9 days, amounting to 2.921 inches; it was raining 60 hours and 42 minutes, and was accompanied by distant thunder on 1 day.

Snow fell on 3 days, amounting to 11.68 inches; it was snowing 46 hours and 35 minutes.

Most prevalent wind, the N. E. by E.

Least prevalent wind, the N.

Most windy day, the 17th; mean miles per hour, 22.53.

Least windy day, the 10th; mean miles per hour, 0.40.

Aurora Borealis visible on 7 nights.

The Electrical state of the Atmosphere has indicated moderate intensity.

Swallow *Hirundo Bicolor*, first seen 23rd day

Frogs *Rana fontanalis*, first seen 24th day.

Wild Geese *Anser Canadiensis*, first seen passing N. W. 23rd day.

Song Sparrow *Frangilla Melodia*, first heard 4th day.

Thatcher's Comet seen 29th.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR MAY, 1861.

Barometer	Highest, the 31st day	30.222
	Lowest, the 27th day	28 883
	Monthly Mean	29.731
	Monthly Range	1.340
Thermometer	Highest, the 26th day	74°3
	Lowest, the 2nd day	21°3
	Monthly Mean	51°86
	Monthly Range	42°9
Greatest intensity of the Sun's rays		85°0
Lowest point of Terrestrial Radiation		19°3
Mean of Humidity		.770

Rain fell on 15 days, amounting to 8.642 inches; it was raining 49 hours and 32 minutes, and was accompanied by thunder on 1st day

Most prevalent wind, W. S. W.

Least prevalent wind, N. N. W.

Most windy day, the 7th day; mean miles per hour, 18.22.

Least windy day, the 15th day; mean miles per hour 0.01.

2 Solar Haloes were visible.

Aurora Borealis visible on 1 night.

The Electrical state of the Atmosphere has indicated feeble intensity.

Shad *Alosa Prostabilis*, first caught 30th day.

Amount of evaporation 2.93 inches.

CORRECTIONS AND ADDITIONS.—In the May Number of the Journal, page 301, line 4 from bottom,—for "Geo. J. Brush, Professor of Mineralogy," read "Professor of Metallurgy." In the present Number, page 328, add *Helix concava* and *Planorbis parvus* to the species there enumerated; and transpose the words "very common" (line 8 from bottom) to the end of the preceding line.

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NOTES ON LATIN INSCRIPTIONS FOUND IN BRITAIN.

PART VIII.

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49. Restorations of imperfect inscriptions, although subjects of agreeable speculation, are generally very hazardous, excepting those cases in which the extant words or letters are parts of *formulæ*, and then a perfectly reliable reading may be supplied from known examples. It is very different, however, when the attempt is made to complete a fragment by supplying facts supposed to have been stated in the missing or mutilated portions. In such cases the restoration, although sometimes ingenious, is scarcely ever more than plausible. A remarkable example is presented by Governor Pownall's well known restoration of the imperfect inscription on stones found in Bath, and believed to have formed part of the frieze of the *temple of Minerva

* The only ancient authority for this temple is the following passage in Solinus :—"*fontes calidi opiparo exculti apparatu ad usus mortalium :* quibus fontibus *præsul est* Minervæ numen, in cujus sede *perpetui ignes nunquam canescunt in favillas, sed ubi ignis tabuit, vertit in globos saxeos.*" The identity of the second syllable of *præ*sul with the Celtic name of the goddess suggests that Solinus may have referred to it when he used the word, but the suspicion is groundless, as he says, in another place, of Angerona :—*diva* præsul *silentii.* Mr. Whitaker seems to have attached great importance to this passage in Solinus, and has built up some theories on it. In his estimate of its value I cannot concur : the facts and the Latinity of Solinus seem to be equally worthless. I am not disposed, however, to question the existence of a temple of Minerva in Bath, as it is otherwise probable.

in that city. The fragments are figured in Warner's *History of Bath, pl.* 1., *fig.* 7, and the words on them are thus read by the Rev. H. M. Scarth, *Journal of British Archæological Association*, 1857, p. 266:

(1.)	(2.)
LAVDIVS · LIGVR	OLEGIO · LONGA · SERIA
E · NIMIA · VETVST	VNIA · REFICI · ET · REPINGI · CVR

From these fragments Governor Pownall invented the following restoration:—

[AVLVS · C]LAVDIVS · LIGVR[IVS · SODALIS · ASCITVS
FABRORVM · C]OLEGIO · LONGA · SERIA · [DEFOSSA
HANC · AEDEM·]E · NIMIA · VETVST[ATE · LABENTEM
DE · INVENTA · ILLIC · PEC]VNIA · REFICI · ET · REPINGI ·
CVR[AVIT·]

The supplied words and letters I have placed between brackets [ ].

*The idea of *Claudius Ligurius* being a member of the College or company of smiths, was evidently suggested, as Mr. Scarth observes, by the inscription to *Julius Vitalis*, in which it is stated that he (*Vitalis*) was *ex *colegio fabrice elatus*. The objections to the use of the words—†*sodalis ascitus fabrorum colegio*—in the con-

* It has been inferred from these words that there was a *fabrica*, *i. e.* a public factory of arms, in or near Bath, although the *Notitia*, whilst noticing similar establishments in different parts of the empire, does not mention it. This, possibly, may have been the fact, but it must be borne in mind, that as *Vitalis* was one of the *fabri* or *fabricenses* attached to the 20th legion, the *collegium*, who manifested their regard for him by a funeral at their expense, may have been the association of smiths or armourers in that legion. Thus in Orelli, n. 4922 we find mention of the *collegia frumentariorum* in the 8th and 13th legions. *Elatus* (Orelli, nn. 4715, 4716) denotes that the corpse was borne to the place of interment on the shoulders—thus Horace, Sat. ii., 5:—

Ex testamento sic est elata : *cadaver*
Unctum oleo largo nudis humeris *tulit hæres.*

Tacitus, *Ann.* i., 8. *Conclamant patres corpus ad rogum* humeris *senatorum* ferendum.

We may also infer that this was a walking funeral, the procession being formed of the members of the guild, who followed the body on foot. FABRICE may stand either for FABRICE[NSIVM]; or for FABRIC[A]E. Orelli, n. 4079, adopts the latter, referring it, however, to the *fabrica* of the legion.

† Governor Pownall seems to have attached undue importance to membership in a *collegium fabrûm*. There were hundreds of such *collegia* or organizations of tradesmen, mechanics, and labourers of every class throughout the Roman Empire. The *collegia fabrum* alone may be counted by dozens; and we are not without examples of *collegia dendrophororum, mulionum et asinariorum, suariorum et confectuariorum*, whose members respectively occupied positions in society about the same as English porters, waggoners, and pork-butchers.

nection in which they appear, are, if the words be intended to mean on the occasion of his election or appointment, the money for the repairing and repainting, should, according to usage, have been provided from his own funds; and if the words be intended merely as an honorary designation, there is no authority, so far as I am aware, for their use in this sense under such circumstances. The words *seria* and *pecunia* suggested the invention of the story about the money having been found in a vessel. The objections to this application of *longa seria defossa* are—the word *longa* seems inappropriate when applied to *seria*, even though its shape is said to have been *oblonga;* and *defossa* does not signify *dug up*, which seems to have been the meaning intended, but *buried*, so that the translation of the words, as they stand, which would first present itself, would be, *a long earthen vessel having been buried*, not *having been dug up*. If *seria* be the correct reading the most probable *prima facie* reference would be to the *seria* which was kept in temples. Thus:

Lamprid. *Heliogab. c.* 6. "Penetrale sacrum [Vestæ] est auferre conatus: cumque *seriam*, quasi veram, rapuisset, atque in ea nihil reperisset, applosam fregit."

But it seems not unlikely that either the true reading of the word on the stone is *serie*, or that the final *a* is a mistake in orthography for *e*. We have thus *longa serie*, and if we supply *annorum*, this phrase and *nimia vetustate* will agree well with *refici et repingi*. Thus in Orelli, n. 3300, we have PERMVLTO TEMPORE VETVSTATE CONLAPSVS. As to the age of the inscription, a surmise may perhaps be formed with some reason from the use of the word *repingi*, a verb, which I do not recollect having seen in any Latin writer earlier than the 6th century, A. D. On the restoration, as a whole, it is unnecessary to say more than that I am persuaded that no one familiar with Latin Epigraphy would mistake it for a genuine inscription; indeed it is not as plausible as many of the Ligorian forgeries.

50. Another example, of the danger of attempting a restoration with insufficient data, is to be found in Mr. C. Roach Smith's remarks on an inscription on a stone found, I believe, at Netherhall, Cumberland.

It is figured in the *Collectanea Antiqua*, ii. pl. 48, fig. 7, and the following (p. 202) are Mr. Smith's observations on it:—

* * * * ILSER *
QVINANAT * * *
GALATIA · DEC
BVIT GALA****
XIT ANN * * * *
MORITV * * * * *
DESIDER * * * * *
RIS·INT * * * * *

"This inscription is incorrectly given by Gordon, and Hodgson does not attempt to restore it. Two lines seem wanting at the beginning and one at the end. What is left may probably be read thus:—*f*IL*ius* SERV*ii* QVI NAT*us* GALATIA DEC*u*BVIT GALATIA *vi*XIT ANNOS · · MORITV*rus* DESIDER*avit pat*RIS IN T*umulo sepeliri?*"

Mr. Wright (*Celt, Roman, and Saxon*, p. 320) gives the translation according to this reading:—

". . . . IL SER	. . . . son of Servius,
QVI NANAT	who born
GALATIA DEC	in Galatia
BVIT GALA . . .	died in Galatia;
XIT ANN	He lived . . . . years;
MORITV	On his death-bed
DESIDER	he desired
RIS INT	in his father's tomb to be buried."

To this is subjoined the following note:—

"The translation of this inscription is made after the ingenious restoration of Mr. Roach Smith, who (*Collectanea*, ii. p. 202) explains it, I believe correctly, as follows:—*f*IL*ius* SER*vii* QVI NAT*us* GALATIA DEC*u*BVIT GALATIA *vi*XIT ANNOS . . . MORITV*rus* DESIDER*avit pat*RIS IN T*umulo sepeliri*. In the second line, NANAT appears to be an error of the stone-cutter for NAT."

In p. 319, Mr. Wright refers to this inscription in the following terms:—

"A broken inscription in one of the stations along the wall of Hadrian commemorates a native of Galatia, whose father having, as it appears, died in Britain, the son, who died in his native country, wished on his death-bed to be carried into Britain to be laid in his father's grave."

This simple statement of the story, as it is told in the restored inscription, manifests its improbability. It is not common, even now, with our increased facilities of transportation, for the bodies of the

dead to be removed such a distance as Galatia was from Britain; and when these cases do occur, they are usually of members of families of distinction or in affluent circumstances, and with the object of having the remains deposited near those of relatives of the deceased in their native lands. Here the case seems to be of a son, whose remains, in accordance with his desire on his death-bed, were removed from his birth-place Galatia, being the place also of his death, to the grave of his father in Britain, whose presence there and whose death there are equally unexplained; and indeed inexplicable, unless on the supposition that he had gone there with the corps in which he was serving, probably as a private soldier. But besides this, at the time of the inscription (to whatever date during the Roman occupation of the island it should be referred) this power of removal seems not to have been at the pleasure of individuals. We know that the Romans did not allow a body, even temporarily interred, to be removed to any other place without the permission of the *pontifices* or other proper authorities. Of this we have an example in Gruter, p. DCVII. n. 1, where we find a copy of the memorial addressed by *Velius Fidius* for permission to remove the bodies of his wife and son from an *obruendarium*, or sarcophagus of clay, to a monument of marble, with the object—*ut quando ego esse desiero, pariter cum iis ponar.* (See p. 14 of *Roman Sepulchral Inscriptions*, a scholarly and very interesting little work, by the Rev. J. Kenrick, of York, England; and Orelli, nn. 794, 2439.) I do not mean to say that there is no authority for the removal of human remains, without a statement of permission, for there are examples, but I think that the absence of the notice in this case of both removal and permission, throws additional doubt on a reading previously highly improbable. It must also be admitted, that the improbability of the removal of the bones, which in those times would, perhaps, be the only remains, is less than that of the transportation of the body.

But if we examine the restoration in detail, we shall, I think, find the degree of improbability considerably increased.

Mr. Smith reads the fragment of the first line thus: [F]IL · SER-[VII]. Now the obvious objection to this reading is, that the order is contrary to usage: the name of the father should precede, and FIL · or F · follow. There can, I think, be but little doubt, that the name of the father was in the mutilated portion of the line before FIL · and that SER · stands for SER[GIA] *tribu*, which is thus in

its proper place. In the second line—QVINANAT— NANA is treated as a blunder of the stone-cutter, who inadvertently doubled the NA, *i.e.* the reading QVI · NAT[VS] is given instead of QVINA· NAT[VS]. Sooner than resort to this uncritical expedient, I prefer regarding QVINA as the *cognomen*,* even though I can produce no example of it. The letters are certainly in the position where the *cognomen* should be expected, scil. after the tribe. The translation of DECVBVIT—"died"—is liable to the objection, that this is not the ordinary meaning of the word. *Decumbere* commonly means "to fall sick," although there are examples of its gladiatorial application, "to fall in death." It is not impossible, however, that it may be used here in the sense—"he took to his bed and never left it alive." The last two lines of the inscription,† as given by Mr. Smith, scil. DESIDER**** RIS · INT**** are restored thus: DESIDER[AVIT · PAT]RIS · IN · T[VMVLO]; and to this is added, to complete the conjectural sense, but without a trace of authority on the stone, the word SEPELIRI.

The objection here is to the Latinity of the phrase *desideravit sepeliri*. So far as I am aware, there is no authority for its use; and the appearance of it in an inscription would, in my judgment, at once suggest doubts of the correctness of the reading or of the genuineness of the inscription.

It is not my intention to suggest any conjectural reading of the inscription which we have been examining; it seems to be too far gone to be within the reach of hopeful critical treatment. I may be permitted, however, to observe, that the reading GALA[VAE], probably the modern *Keswick*, or GALA[TI],‡ the Κάλατον of Ptolemy, is more probable than GALA[TIA]; and that the fragmentary words MORITV**** DESIDER**** may be more plausibly explained as intimating that the deceased pined and died from fretting for his distant or deceased father, mother, or brother, scil. *desiderio patris, matris*, or *fratris*. Thus we have in Henzen, n. 7378:—

* It has occurred to me, that perhaps the true reading is OVINA, a name, of which the first four letters are found in Mommsen, *Inscript. Neapol.* n. 6811.

† In Gordon's *Itinerary*, *pl.* 45, we find NON VA in a line under RIS INT.

‡ The mention of the place of death is so uncommon, that there was probably some special reason for noticing it here. Perhaps the resemblance of *Galatum* to *Galatia* was the cause. It has been identified with *Galacum* of the Itinerary.

D · M · S
TELESINIAE · CRISPI
NILLAE · CONIVGI · SANCTIS
SIMAE · QVAE · OB · DESIDERIVM
P · LALI · GENTIANI · VICTORIS
FILI · SVI · PIISSIMI · VIVERE
ABOMINAVIT · ET · POST · DIES · XV
FATI · EIVS · ANIMO · DESPONDIT
&c. &c. &c.

And in Cicero, *Epist. ad. Attic.* i. 3. *Aviam tuam scito* desiderio tui mortuam esse.

51. That there was a goddess worshipped at Bath under the name *Sul,* there can be no doubt. She is named in inscriptions on four altars, and on a tombstone found in that city. Of the inscriptions on these altars, two of them prove that she was identified with Minerva. The similarity of the name suggests that she may have been the same as *Sulivia Idennica Minerva* in n. 2051, of Orelli's Inscriptions; and also leads to the belief, that there was some connection between her, and the *Sulevæ, Suleviæ, Silviæ,* or *Silvanæ,* mentioned in Orelli's, nn. 2099, 2101, 2103. The terms *Sulevis et Campestribus* in 2101, and *Silvanab. et Quadribis,* (i. e. *Silvanabus et Quadriviis*) favour the opinion, that the *Sulevæ* should be classed amongst the *Matres,* traces of whose worship have been commonly found, especially in Germany, Belgium, and Britain. Mr. Scarth, (Journal of the *Archæological Association,* 1861, p. 16,) regards them as "probably attendant nymphs" of *Sul*; and to Mr. Roach Smith, (*Roman London,* p. 38,) "they appear to have been Sylphs, the tutelary divinities of rivers, fountains, hills, roads, villages, and other localities, against whom were especially directed, in the fifth and subsequent centuries, the anathemas of Christian councils, missionaries, and princes."

Dr. Thurnam, in the very able dissertation on the "Historical Ethnology of Britain," in *Crania Britannica, Dec.* iv. *p.* 130, observes:—

"Under that of *Sul,* a Welsh name of the sun, he (Apollo) was worshipped in Brittany, where, under Christianity, he was represented by a pretended St. Sul. There are traces of this name in that of various hills—Solsbury, Salisbury, Silbury—at Bath, Ribchester, Edinburgh, and Abury, which are so many high places of the Sun-god, or Celtic Apollo." * * * * *

"The Celts had not only a great male divinity representing the Sun, but

likewise a female one symbolising the passive powers of nature, and by whom the Moon (as by the Syrian Astarte or Venus-Urania), was originally intended."

* * * * * * * * *

"The goddess worshipped conjointly with Apollo at Aquæ Solis [or, as others prefer, Aquæ Sulis] was clearly the Celtic Minerva, as appears from the epithet SVL., by which she was there known, and which, like that of Baalsemen [Lord of Heaven,] had both a feminine and masculine application. The Solimara, [Orelli, n. 2050,] worshipped by the Bituriges may have been the same as the British Sul."

52. The following is a copy of the inscription on the Bath altar, in which the *Suleva* are named :

SVLEVIS
SVLINVS
SCVLTOR
BRV[C]ETI · F
SACRVM · F · L · M

Mr. Scarth remarks :—" In the name of the dedicator we have an instance of the name of an individual derived from the presiding deity of the waters [i. e. *Sul*] ; this is also to be remarked on another altar—*Sulinus Maturi fil.*" This account of the etymology of the name seems probable, especially when we call to mind the Greek and Roman usage of forming names of persons from the names of their deities, such as *Hermogenes, Jovinus, &c.*

The *prima facie* interpretation of the three middle lines, *scil.* "Sulinus Scultor, the son of Brucetus," is liable to the objections, that *Sulinus* of the other altar has but one name ; and that " the last three lines of this inscription are in letters much smaller, and not so deeply cut as the first two lines," whence " Mr. Hunter thinks that the first two lines are the original inscription and that the others were added afterwards." This peculiarity suggests the conjecture that the first inscription was left imperfect, and that a different person," 'Scultor, the son of Brucetus' took the vacant space for his inscription consisting of the last three lines. But the Greek and Roman stone cutters seem to have been so capricious as to the size of the letters and the depth of the cutting in the same inscription, that we are scarcely warranted in inferring in this case two inscriptions. I am inclined to think that *Scultor* is not a name of a person, but the designation of an occupation, scil. *sculptor*, the carver or stone cutter, *i. e.* " Sulinus the carver."

This conjecture is supported by the use of the rare formula F. L. M., which I read *fecit libens merito.* If the representation of the altar, as given by Mr Warner in pl. 2, fig. 6, be accurate, there is reason to suspect the reading BRV[C]ETI · F., as in that representation it seems to be more probably BRVCI · FIL ·, or rather BRVSCI · FIL., as in one of the Lincoln inscriptions, noticed in Art. 42 of these notes.

53. The opinion, which I have expressed in the last article, relative to *Sulinus* and *Scultor* is favoured by an examination of the inscription on another altar, scil.:

DEAE
SVLIMI
NERVAE
SVLINVS
MATV
RIFIL
VSLM.

i. e. Deæ Suli Minervæ, Sulinus, Maturi filius, votum solvit libens merito.

It may, I think, be reasonably inferred, from the apparent etymology of the name *Sulinus,* and from the circumstance, that the individual had but one name, that the dedicator was a barbarian, *i. e.* a native Briton, or Gaul. This inference derives support from the order of the words SVLI MINERVAE. If the dedicator had been a Roman, or a Romanized provincial, he would probably have conformed to the usage of placing the designation of the Roman deity first, and that of the identified barbarian deity second. There are many examples of this usage. Amongst the most obvious are *Marti Camulo, Apollini Toutiorigi, Dianæ Abnobæ.*

54. The tomb-stone, to which reference was made in art. 51, bears the following inscription:—

D. M.
C. CALPVRNVS
[R]ECEPTVS SACER
DOS DEAE SV
LIS VIX AN LXXV
CA[LP]VRNIA TRIFO
SA [THR]EPTE CONIVNX
F. C.

Mr. Scarth's remarks on it are :—

"This is expanded thus by Mr. Lysons :—"Diis Manibus Caius Calpurnius Receptus Sacerdos Deæ Sulis, vixit annos septuaginta quinque Calpurnia Trifosa Threpte conjunx faciendum curavit." Mr. Hunter, in the Bath Institution Catalogue, observes that *Receptus* may be an appellation of Calpurnius, or it may signify that he was an "admitted" priest of the goddess Sul."

Of the two interpretations, mentioned by Mr. Hunter, I prefer the former, scil. *Receptus* as a *cognomen:* if the latter had been intended, the order would probably have been *Sacerdos receptus.*

The strangeness of the names of his wife might, perhaps, lead some to question the correctness of the reading, but on examination they will, I think, be found to be free from objection. According to my view of them, they afford evidence that the priest married a Greek slave, that was born and brought up in his house. TRIFOSA and THREPTE suggest that she was Greek, and CALPVRNIA and THREPTE that she had been his slave. TRIFOSA, TRYFOSA, TRIPHOSA and TRYPHOSA are all Latinized forms of a Greek female name, taken, as *Sympherusa, Prepusa, Terpusa* and many others, from the nominative singular feminine of the present participle active, *i.e.*—TRYΦΩΣΑ or τρυφῶσα, from the verb τρυφάω, the same name that is found in St. Paul's *Epist. ad Rom.* xvi. 12. THREPTE, or TREPTE as it is otherwise written, is used as a *cognomen,* but as the female mentioned here already has one, scil. *Tryphosa*—I regard the word as standing for θρεπτή, the Greek term corresponding to the Latin *verna.*

It is scarcely necessary to add, that, according to usage, she took her first name *Calpurnia* from the *nomen gentilitium* of her master.

It is worthy of observation, that two of the altars, dedicated *Deæ Suli,* were erected, probably, by Greek slaves who had been manumitted, viz: *Aufidius Lemnus*, (Lemnius?)* and *Aufidius Eutuches (Eutyches?).* These *liberti* took their names *Aufidius* from their master, *Marcus Aufidius Maximus,* who is mentioned in each of the inscriptions, retaining, according to usage, as *cognomina,* their servile appellations—*Lemnus* (or *Lemnius?*), probably from his birth-place *Lemnos* in the Ægean, and *Eutyches,* from εὐτυχής, lucky. It is well known that some slaves were called after their birth-place *e. gr. Syrus, Geta, Cappadox, &c.*; and others, from reputed or real characteristics. Mr. Warner's supposition (as noticed by Mr. Scarth) that

* In Mommsen's *Inscript. Neapol.* n. 4333, we have LEMNIVS LIBERTVS.

"the name EVTVCHES is EIVS ADOPTATVS HERES" is unintelligible. If his meaning be that the name implies that he was "the adopted heir of his master," there is not the slightest foundation for the supposition, either in the name or in the inscription. Mr. Warner with equally little reason supposes the two altars to have been erected by the same freedman. Mr. Hunter and Mr. Scarth infer from the name CALPVRNIVS the rank of this priest as "a member of the noble Calpurnian family." To me there seems to be no ground for this inference; indeed, so far as we know, he may have derived this name, as a *libertus*, from the *nomen gentilitium* of his master. As to his connection with *Quintus Calpurnius Concessinius*, "legate in Britain under Caracalla," it is sufficient to observe, that there was no person of that name who is known to have held the office of legate. Mr. Wright, (*Celt, Roman, and Saxon*, p. 358), mentions an individual with the first two of these names as a governor of Britain, "believed to be of the age of Commodus," but this statement is erroneous. The only *Quintus Calpurnius Concessinius*, known in inscriptions found in Britain, was a *præfectus equitum*. *Vide* Horsley, *Brit. Rom.*, *Northumberland*, cviii, and art. 9 of my notes.

55. Since the publication of Part VI., I have had the opportunity of perusing extracts of letters from the late Sir S. Rush Meyrick to the late Samuel Lysons, Esq., and from the late Sir Wm. Drummond to the late Rev. Danl. Lysons, on the subject of the God *Nodons* or *Nodens*. Sir Samuel Meyrick was of opinion that "Deus Nodens "seems to be Romanised British, which correctly written in its original "language would be Deus Noddyns, *i.e.*, the god of the abyss, or it "may be 'God the preserver,' from the verb noddi, to preserve, both "words being derived from *Nawdd* which signifies 'protection.' I "think the latter translation best expresses the idea of Silvianus, and it "exactly answers to another epithet of the British deity, as mentioned "on an altar in Camden, found at Wigton, in Cumberland (Gough's "Edit. iii. p. 172)—DEO CEADIO, &c.

"Instead of Cea*d*io Camden writes Cea*i*co, but as in numerous in-"stances he puts ÆO for DEO, and such like, I think he may be "presumed to have mistaken the *d* for an *i*. Duw Ceidiaw is 'God the "preserver.'" There are but few, I think, who will view this etymology with any favour. Sir Wm. Drummond in his first letter on this subject takes the same view as that which I expressed in article 34, and

cites almost the same passages in illustration. Subsequently, however, whilst retaining the opinion that the *Nodinus* of Varro, otherwise the *Nodutùs* of St. Augustine and Arnobius, was originally the same deity as the *Nodens* of the inscription, he identifies him with Æsculapius. "The emblems," "he remarks, "said to have been found "along with the inscription, serpents, cocks, and dogs, seem strongly to "confirm, nay, even to prove, the truth of this supposition" [originally advanced by Mr. Bathurst, that the deity in question could be no other than Æsculapius]. This leads him to search for another etymology for the name of the god as given in the inscriptions, and, with the help of certain peculiarities of the Etruscan language and letters, to which he believes the Latin "bore a considerable resemblance until about the 5th century after the foundation of Rome," and the further aid of the fact, that the worship of Æsculapius was introduced into Rome about that period, scil. 461, A. U. C.; he arrives at the conclusion that *Nodens* or *Nodons* is a corruption of *Nodunos*, *i.e.*, *νώδυνος*, *alleviator of pain*, than which "no name or epithet was more likely to be given by the Greeks to Æsculapius, who was supposed to be the inventor of medicine, and to whose salutary influence was ascribed the restoration of health." Of this theory it seems unnecessary to say more than that there is no authority for the application of the epithet νώδυνος to Æsculapius. and that there is no ground for questioning the received opinion, that the deity *Nodutus*, or *Nodinus*, derived his name from his office of presiding over the *nodi*. Any doubts, however, which I had as to the influence which *Nodons* was believed to possess over human health, have been removed by a notice of the site of the deity's temple in "*The Proceedings of the Archæological Institute, Bristol*, 1851." In a paper on "the British and Roman Roads communicating with Caerwent," Dr. Ormerod observes: "Between the Town of Lydney and Ailburton, it [the road] appears next as a hollow way between the present road and the hills on the right crowned with two Roman camps, of which one contains the remains of the once splendid temple dedicated to a deity of supposed sanitary powers, and is most rich in antiquities."

To this is subjoined the following note:—

"Within the greater camp, when excavated under directions of its owner, the late Rt. Hon. Chas. Bathurst, were discovered the foundation walls of an irregular quadrangle, the sides of which average severally about 200 feet, exclusive of a range of offices along the N. W. side, and of a Palatial fabric on its upper or N. E. side.

"This fabric, once, possibly, the residence of Flavius Senilis, hereafter mentioned, had a portico along its west front, and an open court in the centre, surrounded by corridors, in which, and in various other apartments, tesselated pavements occurred. This building measured about 150 by 135 feet.

"On the north side of this building, separated from it by an open space, were baths and Hypocausts, with a detached building measuring about 125 feet in length by 70 in greatest breadth.

"Near the centre of the principal quadrangle was (as is supposed) the temple of the tutelary deity, the "TEMPLUM NODENTIS," mentioned in the Inscription below. It was about 95 feet long by 75 broad, and in it were three tesselated pavements, the largest having the name of the erector (as in IV.) placed over a fanciful border representing the twisted bodies of salmons, the fish of the Severn.

"The whole was excavated under the direction of its late owner, the relics and coins carefully preserved, plans and drawings taken, and a series of engravings (of very limited number) executed, in which were eleven tesselated pavements. All was then covered again for preservation. Among the relics are coins to the time of Allectus inclusive, a statuette, votive offerings of limbs supposed to be acknowledgments of the sanitary powers of Nodens or Nodons, and three votive inscriptions given below, together with the inscription in the Temple. No. III. has been printed by Lysons, the others are not known to have been published, and are given with their errors of grammar and spelling:

I. D . M . NODONTI .
I . L . BLANDINVS .
ARMATVRA
V . S L M

II. PECTILLVS .
VOTUM . QVOD .
PROMISSIT .
DEO . NVDENTE .
M . DEDIT .

III. DIVO .
NODENTI . SILVIANVS .
ANILVM . PERDEDIT .
DEMEDIAM . PARTEM .
DONAVIT . NODENTI .
INTERQVIBVS . NOMEN .
SENICIANI . NOLLIS .
PERMITTAS . SANITA—
TEM . DONEC . PERFERAT .
VSQVE . TEMPLVM . NO—
DENTIS .

IV. Imperfect, but the seeming number of the deficient letters is shown by points, as follows:

D . A . . . FLAVIUS . SENILIS . PR . REL . EX . STEPIBVS .
POSSUIT O . . . . ANTE . VICTORINO . INTER . . . ATE."

From these statements, it may, I think, be reasonably inferred, that this temple was the resort of persons seeking relief from sickness, and that the cocks, serpents, and dogs, as well as the limbs found there, were votive offerings of those who gratefully acknowledged the sanatory powers of the deity worshipped in the place.

The circumstance that limbs were offered, leads to the conjecture that the diseases cured here were such as affect these portions of the body, perhaps rheumatism and gout, the influence of which is felt in the joints, the *nodi*, whence we find *nodosa cheragra*, or *podagra*. And this further suggests the query,—whether the same deity presided over vegetable and animal *nodi?* But—to turn from mere conjecture to something more certain—the inscriptions, marked I. II. and III. are the same as those which formed the subjects of my articles 35, 36, and 37.

The only thing worth noticing regarding them is, that, as given by Dr. Ormerod, they present one or two different readings. They are, however, of no importance; but n. IV. is particularly deserving of attention. The beginning is unfortunately so imperfect, that I can offer no explanation which satisfies me. If the D be regarded as standing for *Deo* or *Dei*, it is not easy to find a suitable word or abbreviation of four* letters, commencing with A. *Aram* (or *Adem?*) seems the most plausible. It is possible that D. A... may be *prænomina* of *Flavius Senilis*, scil. Decimus Aulus, the A and V being ligulate. The abbreviations PR · REL · are also doubtful, from the want of authority. It seems probable to me, however, that they stand for PR[ETIO]† REL[ATO], the cost [of the structure or altar] having been obtained *ex stipibus*, *i.e.* the small pieces of money offered by the votaries of the god, either voluntarily or at the solicitation of the priests, who, like others of their order, during a portion of the day,—"*post templi apertionem* stipes *emendicabant*." The portion of the inscription—*ex stepibus* [stipibus] *possuit* [posuit]—may be well illustrated by an inscription to *Mercurius Augustus*, found at Yverdun, in Switzerland, *Orelli*, n. 348.

DONA VENIBVNT
AD ORNAMENTA EIVS
ET EX STIPIBVS
PONENTVR ·

* This limitation excludes the conjectures, otherwise plausible, AGREST · or AGRIC ·

† The following may also be suggested: pr[eses], pr[esul], or pr[efectus] rel[igionis].

This I interpret as meaning that the gifts offered to Mercury, whose statue is referred to in the preceding portion of the inscription, shall be sold to purchase decorations, and the cost of putting them up shall be defrayed from the money-offerings, or what we may call penny contributions.

O .... ANTE · VICTORINO · INTER ... ATE · I regard as standing for OP · CVRANTE · VICTORINO · INTERAMNATE, *i.e. Opus curante Victorino Interamnate*, Victorinus, an Interamnian, (*i.e.* as I understand it, a native of the country between the rivers Wye and Severn), directing the work.

The word INTER .... ATE seems to me to explain INTER, in line six of the third inscription, about the meaning of which I expressed doubts in my former article on the subject. I now regard it as an abbreviation of INTERAMNATI, an epithet given to Nodon, from the situation of his temple and the position of the district in which he was specially worshipped, *i.e.* NODENTI · INTERAMNATI; as we find *Hercules Tiburtinus, Juno Albana, Jupiter Poeninus, Apollo Actiacus*, &c.

I avail myself of this opportunity to add what I inadvertently omitted mentioning in my former article, that I trace the use of a tablet of lead for this inscription to the fact, that this material was used in recording execrations and for magical *defixiones*. Thus in Tacitus, *Ann.* ii. 69,—*nomen Germanici* plumbeis tabulis *insculptum*, is noticed amongst the *maleficia quîs creditur animas numinibus infernis sacrari;* and Dio Cassius (lvii. 18), whilst telling the same story of Piso's machinations against the life of Germanicus, says: ἐλασμοὶ μολίβδινοι ἀράς τινας μετὰ τοῦ ὀνόματος αὐτοῦ ἔχοντες.

56. The principal remains of Roman metallurgy in Britain are blocks of lead, presenting an appearance of which a good idea may be formed from the subjoined wood-cut.*

(Weight, nearly 156 lbs.; upper, or larger, surface, 24 in. by 5 in.; inscribed surface, 21 in. by 3½ in.; thickness, 5 in.)

* Copied from a wood-cut, in *Journal Arch. Assoc.*, vol. v., illustrating an article, by Mr. C. Roach Smith, which contains much valuable information relative to these blocks.

Mr. Albert Way, in an excellent article (*Journal of Archæological Institute*, 1859, n. 61), has carefully collected the scattered notices of all the relics of this class, which have at various times been found in Britain, and has thus produced a valuable *précis* of almost all that is known on the subject.

The blocks, or "pigs," according to the information given in that article, present the following varieties of inscription:

(1) BRITANNIC**AVG II. (*a*)
(2) TI·CLAVDIUS·CAESAR·AVG·P·M·TRIB·P·VIII·IMP·
XVI·DE·BRITAN. (*b*)
(3) TI·CL·TR·LVT·BR·EX·ARG. (*c*)
(4) NERONIS AVG·EX KIAN $\overline{\text{IIII}}$ COS BRIT. (*d*)
(5) IMP·VESP·$\overline{\text{V}}$::T·IMP·$\overline{\text{III}}$·COS. (*e*)
(6) IMP·VESP·$\overline{\text{VII}}$·T·IMP·$\overline{\text{V}}$·COS. (*f*)
(7) IMP·DOMIT·AVG·GER·DE
CEANG. (*g*)
(8) IMP·CAES·DOMITIANO·AVG·COS·VII. (*h*)
(9) CAESAR ***** VADON. (*i*)
(10) IMP·CAES·HADRIANI·AVG·MET·LVT. (*k*)
(11) IMP·HADRIANI·AVG. (*l*)
(12) IMP·DVOR AVG ANTONINI
ET VERI ARMENIACORVM. (*m*)
(13) L·ARVCONI·VERECVNDI·METAL·LVTVD. (*n*)
(14) C·IVL·PROTI·BRIT·LVT·EX·ARG. (*o*)

It is plain, on inspection, that the simplest of these are nn. (2), (5), (6), (8), (11), and (12). We shall therefore take these up first, and then proceed to the more obscure.

(*a*) Found on Blackdown Range, Mendip Hills, Somerset.
(*b*) Found near Wokeyhole, Somerset.
(*c*) Found at Matlock, Derbyshire; also in Pulborough, Sussex.
(*d*) Found near Stockbridge, Hants.
(*e*) Found about a mile from Chester, on the road to London.
(*f*) Found at Hints, Staffordshire; also on the coast of Cheshire.
(*g*) Found on the coast of Cheshire.
(*h*) Found about eight miles from Ripley, in Yorkshire.
(*i*) Found near Common Hall Street, Chester.
(*k*) Found near Matlock, Derbyshire.
(*l*) Found about ten miles from Shrewsbury, Shropshire; also about seven miles north of Bishop's Castle, Salop; also about four and a half miles from Montgomery, Shropshire; also near Sydney Buildings, Bath.
(*m*) Found at Bruton, Somerset.
(*n*) Found upon Matlock Moor, Derbyshire.
(*o*) Found about six miles from Mansfield, Nottinghamshire.

(2) Ti[berius] Claudius Cæsar Aug[ustus] P[ontifex] M[aximus] Trib[unitia] Pot[estate] viii. Imp[erator] xvi. de Britan[nis].

The date is A.D.49.

Following Mr. Way, I have regarded the object of lead, bearing this inscription, as a pig. Leland, *Collect. Assert. Artur.* v., p. 45, describes it as *trophæum ex oblonga plumbi tabula.* Similarly Camden, i., p. 82, (*Gough's edit.*) but Gough, p. 104, applies the term "pig" to it. In the *Monum. Hist. Brit.* it is called *lamina.* The learned author of the *Historical Ethnology of Britain, Cran. Brit., Dec.* iii., *chap. V., p.* 101, speaks of it as "often described as a pig, but really an oblong plate, 'oblonga plumbi tabula,' and part, probably, of a trophy.' It is plain from the context of the passage in which Leland mentions it that it was not a *lamina* or sheet, for just before noticing it he more than once mentions *laminæ plumbeæ,* but in describing it substitutes, for *lamina, tabula,* the difference being, as I understand, that the latter was thicker.

Mr. Way (p. 22) speaks of these objects generally as "the *massæ plumbi,* Ἐλασμοὶ μολίβδινοι of Dion, in the mediæval times termed *tabulæ.*" The passage in Dion, referred to by Mr. W., is the same that I have cited on page 15, and there can, I think, be but little doubt that the ἐλασμοὶ mentioned there, were what the ancient Romans called *tabulæ.*

The idea of its being a trophy was, I conceive, suggested by the name being in the nominative, and by the use of the preposition *de* which seems to denote that the object was not an article of commerce or of tribute, but of spoil; thus Virgil, *Æn.* iii., 288, *Æneas hæc de Danais victoribus arma.* This supposition derives support from the use of the same formula—*de Britannis*—on the coins of Claudius of the years 46 and 49, A. D., which also bear on the reverse a triumphal arch surmounted by an equestrian statue between two trophies. The first issue of these coins was most probably to commemorate the completion of the triumphal arch decreed for his triumph over the Britons in A. D. 44, and the second, which bears the same legend as this object of lead, was in honor of his enlargement of the pomœrium in A. D. 49. It seems no improbable supposition, that objects of lead were prepared in Britain to grace the triumphal procession on the first occasion and some pageant on the second. It is possible, too, that the word *tropæum* may correctly designate one of these objects, as a trophy won from conquered ene-

mies, or as intended to form* part of a trophy. Even with these admissions, however, it may have been "a pig," for the block, as well as the plate, seems appropriate for the purpose. On the whole, I am inclined to think that it was of the same class of leaden objects as that bearing the inscription IMP·DOMIT·AVG·GER·DE CEANG. If this be, as seems to be universally admitted, "a pig," then it is probable that the other of Claudius DE BRITAN· was the same. Leland seems to have applied the term *tabula* to one of those objects which others after his time called *massæ*.

(5) Imp[eratore] Vesp[asiano] v. T[ito] Imp[eratore] iii. Co[n] s[ulibus].

The date is A.D. 74.†

(6) Imp[eratore] Vesp[asiano] vii. T[ito] Imp[eratore] v. Co[n] s[ulibus].

The date is A.D. 76.‡

(8) Imp[eratore] Cæs[are] Domitiano Aug[usto] Co[n] s[ule] vii.

The date is A.D. 81, and refers to the last three months and a half of the year, for Titus died on the 13th of September.

On the side of one of the blocks, bearing this inscription, the letters BRIG· are found, which have been interpreted very probably as referring to the *Brigantes*, in whose territories the lead was produced.

(11) Imp[eratoris] Hadriani Aug[usti].

The date is A.D. 117—138.

(12) Imp[eratorum] duor[um] Aug[ustorum] Antonini et Veri Armeniacorum

The date is A.D. 164—169.§

We shall now take up n. (7), as there is but one word in it the interpretation of which is obscure. It may be read thus: Imp[erator] Domit[ianus] Aug[ustus] Ger[manicus] de Ceang[is].

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* There is a passage in Statius, *Silv.* iv. 3, which at first sight seems to support this supposition, scil.:

> "*Hujus janua, prosperumque limen*
> Arcus, *belligeri Ducis* trophæis
> *Et totis Ligurum* nitens metallis."

Statius, however, both here and elsewhere, uses *metalla* in the sense of "slabs of marble."

† Mr. Way, in the heading of his notice of this pig, assigns it to the right date, but inadvertently gives "VESPASIAN, third Consulate;" instead of "VESPASIAN, fifth Consulate, and TITUS, third Consulate."

‡ In the heading of Mr. Way's notice of this pig also, there is a similar slip. Instead of "VESPASIAN, fifth Consulate," as given, he intended "VESPASIAN, seventh Consulate, and TITUS, fifth Consulate."

§ Mr. Way gives as the date 163—169. This is correct, so far as it relates to Verus; but Antoninus did not take the title *Armeniacus* until 164, and here the epithet is applied to both.

The date is A.D. 84—96.*

The *Ceangi* mentioned here, and also in the inscriptions on the sides of the blocks bearing nn. (5) and (6), seem to be the same as the *Cangi* of Tacitus, *Ann.* xii. 32: *ductus in* Cangos *exercitus.* Different opinions have been formed relative to their position. Camden (Gough's Edition, i. 82), Gibson, Gough, and the author of the Index of the *Monum. Hist. Brit.* place them in Somersetshire. Camden subsequently (iii. 45) altered his opinion, and was inclined to place them in Cheshire. Thus also Latham (Smith's *Dic. Gr. and Rom. Geogr.*) regards "North Wales as a likelier locality" than Somerset. In this opinion I concur. The position suits better the description of Tacitus—*jam ventum* haud procul mari quod Hiberniam insulam aspectat. It accords also with the situation of *Cancanorum* (or *Ganganorum*) *Promontorium* of Ptolemy, and Flintshire, in which and the adjoining counties of Cheshire and Denbighshire, I would place them, was probably even then noted for its lead-mines, at present the most productive in the island.

Horsley and the author of the *Index Monum. Hist. Brit.*, identify the *Cancanorum promontorium* as *Brachypult point*, in Carnarvonshire, which suggests that the *Cangi* may have occupied that county also. I am inclined to suggest *Great Orme's Head.*

As it is most probable that Domitian did not receive the title *Germanicus* until 84 A.D., we may take this date for this inscription: and it seems no improbable supposition that this was one of a set of blocks prepared for transmission to Rome, with a view to being exhibited at his triumph, which took place in that year. It will be remembered that, on Domitian's accession, Agricola was pursuing his successful career in Britain, and that 84 A.D. was the year of his seventh campaign.

We shall now take up the remaining inscriptions. Of these, nn. (1) and (9) are imperfect; and the difficulties in interpreting the others arise from LVT · in nn. (3), (10), and (14); MET · LVT · in n. (10), and METAL · LVTVD · in n. (13); EX · ARG · in nn. (3) and (14); and TR · and BR · in n. (31). As various explanations have been given of these abbreviations, we shall first investigate their meaning, and then proceed to the inscriptions themselves.

* Mr. Way gives as the date 81—96; but Domitian did not obtain the title *Germanicus* until after his reputed victory over the *Catti*, in the close of 83 or the beginning of 84. Eckhel, *Doct. num. vet.* vi. p. 396, has sufficiently refuted the notion that Domitian assumed this title on his accession.

ILLUSTRATIVE EXAMPLES OF SOME MODIFYING ELEMENTS AFFECTING THE ETHNIC SIGNIFICANCE OF PECULIAR FORMS OF THE HUMAN SKULL.

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The antiquity and wide geographical diffusion of the practice of cranial deformation on the American continent, have tended in some degree to divert the attention of craniologists from causes, some, at least, of the operations of which have been long recognised in other departments of natural history. The palæontologist is familiar with the occurrence of skulls distorted or completely flattened, and even with solid bones and shells greatly changed in form by compression. It was due to such compression transforming the skull of a fossil batrachian into some rude resemblance of the human cranium, that the famous *Cryptobranchus Scheuchzeri*, found in a quarry at Œningen in 1725, was announced to the world in M. Scheuchzer's "*Homo diluvii testis et theoscopos*," as the remains of one of the sinful antediluvians who perished in the Noahic deluge! In some of such examples, the palæontologist looks in reality only on the cast of the ancient bone or shell, compressed along with its matrix, probably at a date long subsequent to its original deposition. But in the following examples of similar changes affecting the human skull it will be seen that the distortion by which the crania now referred to have acquired their abnormal shapes, must have taken place at no long period subsequent to inhumation, while the animal matter still remained in such abundance as to preserve the flexibility of the bones; and even in some cases when the soft tissues still existed to resist the fracture consequent on the pressure of the superimposed weight of earth or stone.

In the Museum of the University of Toronto a female skull is now preserved, recovered in 1859 from an ancient Indian cemetery on the Georgian Bay. It is marked by considerable prolongation of the occiput, and is essentially a dolichocephalic cranium ; but the natural excess in the longitudinal diameter has been exaggerated by great lateral compression, under which the left parietal and temporal bones, after being depressed and flattened, have at length partially yielded at the squamous suture. The head appears to have lain on the left side,

and to have been subjected to slow continuous pressure which modified the contour of the lower side before the bones gave way at the suture. The measurements of this skull are:

Longitudinal diameter	7. 40
Parietal diameter	4. 95
Frontal diameter	4. 10
Vertical diameter	5. 35
Intermastoid arch	13. 30
Occipito-frontal arch	14. 00
Horizontal circumference	20. 00

In an interesting paper on "Aboriginal Antiquities recently discovered in the Island of Montreal," published by Dr. Dawson in the "*Canadian Naturalist*," he has given a description of one female and two male skulls, found along with many human bones, at the base of the Montreal Mountain, on a site which he identifies with much probability, as that of the ancient Hochelaga, an Indian Village visited by Cartier in 1535; and which he assigns on less satisfactory evidence to an Algonquin tribe. Since the publication of that paper, my attention has been directed by Dr. Dawson to two other skulls, a male and female, discovered on the same spot, both of which are now in the Museum of McGill College, Montreal. One of these furnishes a still more striking example of a cranium greatly altered from its original shape subsequent to interment. It is the skull of a man about forty years of age, approximating to the common proportions of the Iroquois and Algonquin cranium, but with very marked lateral distortion, accompanied with flattening on the left, and bulging out on the right side. There is also an abnormal configuration of the occiput, suggestive at first sight, of the effects produced by the familiar native process of artificial malformation. This tends to add, in no slight degree, to the interest which attaches to the investigation of such illustrations of abnormal craniology; as the occurrence of well established examples of posthumous deformation among crania purposely modified by artificial means exhibits in a striking manner the peculiar difficulties which complicate the investigations of the naturalist when dealing with man. The evidence which places beyond doubt the posthumous origin of the distortion in this Hochelaga skull is of the same nature as that which has already been accepted in relation to an example recovered from an Anglo-Saxon cemetery at Stone, in Buckinghamshire. The forehead is

flattened and greatly depressed on the right side, and this recedes so far, owing to the distortion of the whole cranium, that the right external angular process of the frontal bone is nearly an inch behind that of the left side. The skull recedes proportionally on the same side throughout, with considerable lateral development at the parietal protuberance, and irregular posterior projection on the right side of the occiput. The right superior maxillary and malar bones are detached from the calvarium, but the nasal bones and the left maxillary remain in situ, exhibiting, in the former, evidence of the well developed and prominent nose characteristic of Indian physiognomy. The bones of the calvarium, with one slight exception, have retained their coherence, notwithstanding the great distortion to which it has been subjected, though in this example ossification has not begun at any of the sutures. The exception referred to is in the left temporal bone, which is so far partially displaced as to have detached the upper edge of the squamous suture. Part also of the base of the skull is wanting.

The posthumous origin of the distortion of this skull is proved beyond dispute on replacing the condiles of the lower jaw in apposition with the glenoid cavities, when it is found that, instead of the front teeth meeting the corresponding ones of the upper maxillary, the lower right and left incisors both impinge on the first right canine tooth, and the remaining teeth are thereby so displaced from their normal relation to those of the upper jaw, as to preclude the possibility of their answering the purpose of mastication—which their worn condition proves them to have done,—had they occupied the same relative position during life.

The extreme distortion which this skull has undergone is still more apparent when looking on it at its base. The bone has been fractured, and portions of it have become detached under the pressure, while the mastoid processes are twisted obliquely, so that the left one is upward of an inch in advance of the right.

The circumstances under which this Indian skull was found tend to throw some light on the probable process by which its posthumous malformation was effected. It was covered by little more than two feet of soil, the pressure of which was in itself insufficient to have occasioned the change of form. The skull, moreover, was entirely filled with the fine sand in which it was embedded. If, therefore, we conceive of the body lying interred under this slight covering of soil until all the tissues and brain had disappeared, and the infiltration of

fine sand had filled up the hollow brain-case; and then, while the bones were still replete with animal matter, and softened by being filled with moist sand and embedded in the same, if some considerable additional pressure, such as the erection of a heavy structure, or the sudden accumulation of any weighty mass, took place over the grave, the internal sand would present sufficient resistance to the superincumbent weight, applied by nearly equal pressure on all sides, to prevent the crushing of the skull or the disruption of the bones, while these would readily yield to compression of the mass as a whole. The skull would thereby be subjected to a process in some degree analogous to that by which the abnormal developments of the Flathead crania are effected during infancy, involving as it does, great relative displacement of the cerebral mass, but little or no diminution of the internal capacity. The discovery of numerous traces of domestic pottery, pipes, stone implements and weapons in the same locality, furnishes abundant proof that it was the site of the Indian village as well as the cemetery, and thereby demonstrates the probability of the erection of such a structure, or the accumulation of some ponderous mass over the grave, at a period so near to that of the original interment, as would abundantly suffice to produce the change of form described. To some such causes similar examples of posthumous cranial malformation must be ascribed; as they are so entirely exceptional as to preclude the idea of their resulting from the mere pressure of the ordinary superincumbent mass of earth.

Another skull found in the same ancient Indian cemetery, apparently that of a female. and now in the collection of M. Guilbault, of Montreal, has also the appearance of having been modified in form by artificial means, whether posthumous or otherwise. The supercilliary ridges are prominent, the frontal bone is receding, but convex, and the occipital bone has considerable posterior projection, which is rendered the more prominent by a general flattening of the coronal region, and a very marked depression immediately over the lambdoidal suture, probably the result of unequal posthumous compression. The abnormal conformation of this skull is shown in the proportions of the intermastoid arch, which measures only 11.75, while the normal mean, so far as ascertained by me from measurements of thirty-three examples of Algonquin crania is 14.34, aud of thirty-six examples of Huron crania is 14.70.

The great importance now justly attached to the form and relative

proportions of the human skull, as elements of classification in physical ethnology, confers a new significance on all external forces affecting its normal ethnic condition. Influences artificially superinduced upon those conditions which, in relation to all other animals, would be regarded as their natural state, tend greatly to complicate that novel department of Natural History which deals with man as its peculiar subject; and in no respect is this more apparent than in the form of the human head. It is man's normal condition to be subjected to many artificial influences; and this fact must never be lost sight of by the ethnologist. In the rudest stage of savage life, which is sometimes, on very questionable grounds, characterised as a state of nature, man clothes and houses himself, makes and uses weapons and tools, and subjects his infant offspring to many influences dependent upon hereditary custom, taste, or superstitious obligations. All these tend to leave permanent results stamped on the individual, and when universally practised, confer on the tribe or nation some artificial ethnological characteristics which are nevertheless as essentially foreign to any distinctive innate peculiarity, as tatooing, circumcision, or other similar operation admitting of universal application. The naturalist has to deal with nothing analogous to this among the most ingenious and constructive of the lower animals.

Diverse physical characteristics have been noted among the various tribes of mankind, but concurrent opinion points to the head and face as embodying the most discriminating tests of ethnic variety. Yet these are the very features most affected by artificial appliances. Tatooing, nose, lip, and ear piercing; filing, staining, and extracting the teeth; staining the eyelids, shaving and plucking the head and beard, all effect important changes on the physiognomy. Nor is the head more constant in its proportions. Undesignedly and with deliberate purpose alike, artificial means tend to modify the shape of the human skull, and so to introduce elements of confusion and error into any system of classification based on cranial conformation, in which such sources of change are overlooked. In one respect, however the American ethnologist might seem to incur little risk of such oversight. The barbarous custom of giving artificial forms to the skull is practised as sedulously at the present day among the Flathead tribes of the Pacific, as by the Peruvians before the conquest of Pizarro, or on the shores of the Euxine among the Scythian Macrocephali in the days of Hippocrates. The effects resulting from this practice have

accordingly assumed a prominent place among the phenomena specially distinctive of American ethnology. But, on this very account, such artificial cranial distortion, especially among ancient and modern American tribes, now receives so much attention from the craniologist, that we are apt not only to forget how entirely this barbarous practice had been lost sight of until the recent revival of the subject, as one necessarily involved in determining the true significance of generic forms of the human head in the deductions of physical ethnology; but also to ignore all other causes tending to produce corresponding results.

The possibility of artificial modifications of the form of the human skull, after having been denied by Sabatier, Camper, and Artaud, was reasserted in strong terms by Blumenbach, when describing a flattened Charib skull brought from the island of St. Vincents. Nevertheless opinions oscillated with varying uncertainty on this disputed question; and even after the publication of Dr. Morton's *Crania Americana* had furnished a complete history of the practice, and abundant illustrations of its results, the artificial origin of such cranial malformation was still denied by eminent anatomists and physiologists. The celebrated anatomist, Tiedmann, after careful inspection of the distorted skulls brought by Mr. Pentland from the ancient sepulchres of Titicaca in Peru, still maintained that their singular forms were entirely due to natural causes; and this idea appeared to receive remarkable confirmation from opinions published by Dr. Tschudi, after personal examination of numerous skulls and mummies exhumed during his travels in Peru. Without denying that some of the peculiarities of cranial conformation frequently observed in skulls found in ancient Peruvian graves are the result of artificial deformation, purposely superinduced by bandaging and mechanical pressure during infancy: Dr. Tschudi maintains that diverse natural forms of skull pertain to different ancient races of Peru, and especially that one peculiar and extremely elongated form of head is a natural Peruvian characteristic. In confirmation of this he not only refers to mummies of children of less than a year old, belonging to the tribe of Aymaraes, exhibiting the dolichocephalic proportions observed in adult skulls: but the very same specialities which he had noted in adult crania of the Huancas came under his observation in more than one mummied fœtus, which could not have been subjected to any artificial apparatus for the purpose of modifying the cranial configuration. In proof of this, he makes special reference to

a fœtus in his possession found enclosed in the womb of a mummy discovered, in 1841, in a cave at Huichay, two leagues from Tarma, in Peru. Professor D'Outrepont, an experienced obstetrician, determined the age of the fœtus at about seven months; and Dr. Tschudi refers to his illustrative drawing of it as affording interesting and conclusive proof, in opposition to opinions advanced by the advocates of mechanical pressure as the sole cause of the remarkable cranial forms recovered from Peruvian sepulchres. Similar proofs are also stated by him to be furnished by another mummy, preserved under the direction of Don Mariano Edward de Rivero, in the National Museum at Lima. The heads exhibit a flattened, receding forehead, and a remarkable posterior elongation; and these characteristics are no less markedly noticeable in another example, from the same Lima collection, figured by Dr. Tschudi in his "*Antiqüedades Peruanas,*" of a mummied child of the Opas Indians. Its form, as shewn both in profile and vertical view, is only comparable to the most depressed skulls of the Chinook Indians; while in the vertical or front view, it is seen to be exceedingly unsymmetrical. The right side is considerably in excess of the left, as is frequently the case in the elongated skulls of the Flatheads of Oregon and British Columbia; and to those familiar with the irregular development of artificially compressed heads, the idea of mechanical pressure is at once suggested as the cause of some of the peculiar cranial characteristics of this Lima mummy.

There is conclusive evidence, I conceive, to prove that there were essentially distinct dolichocephalic and brachycephalic tribes among the ancient Peruvians; and that a markedly elongated head was common, apart from any artificial anterior depression and abnormal elongation to which it was frequently subjected. This question has been discussed, with varying results, in more than one of Dr. Morton's papers, though latterly he appears to have rejected the idea of two or more distinct cranial types, in favour of his theoretical unity of the American race. I have been confirmed in the belief in the existence of such essentially diverse South American cranial types after examining numerous Peruvian crania, including those of the Morton Collection, along with later additions, in the cabinet of the Academy of Natural Sciences at Philadelphia; and especially from recent careful study of a collection of Peruvian mummies and skulls, including both normal and compressed dolichocephalic crania, brought from ancient cemeteries of South America, by Mr. John H. Blake, and now preserved in his col-

lection at Boston, along with other interesting illustrations of the ancient arts and customs of the Peruvians. This primary distinction in the forms of Peruvian crania, apart from the changes wrought on them by artificial means, must be borne in remembrance while estimating the bearings of such evidence as that adduced by Dr. Tschudi from the Opas Indian mummy; for assuredly no conceivable amount of change in the progress from infancy to maturity, could convert the elongated head figured in Rivero and Tschudi's Atlas, into the brachycephalic cranium frequently pertaining to the ancient Peruvian adult. But while evidence derived from various sources tends to confirm the opinion that at least two, if not three essentially distinct forms of head, prevailed among the ancient Peruvians, the evidence produced by Dr. Tschudi fails to prove that the examples referred to by him ought to be accepted as illustrations of a normal cranial type.

In this as in so many other departments of Ethnology, the naturalist cannot be too frequently reminded that the most primitive condition of man's savage life is an artificial one when compared with that of any of the lower animals. With man alone the osteologist finds his investigations complicated by altered forms produced by artificial means; and under this head must be included the accidental and undesigned, as well as the purposely superinduced changes effected on the human frame, and especially on the skull; while to causes thus operating to modify or counteract the normal vital functions, have to be added others, illustrated by the examples produced above, and clearly traceable to a posthumous origin.

The intra-uterine position of the Huichay cave fœtus furnishes indisputable proof that its peculiar cranial development is not due to art: if by this is understood the application of mechanical pressure with an express view to the production of such configuration; but this by no means exhausts the possible sources of abnormal modification. It may be the undesigned result of mechanical pressure inevitable in the process of dessication, accompanied as it invariably was, in the case of Peruvian mummies, with the forcing of the body into a crouching position, in which the legs were compressed upon the abdomen, and the arms folded across the chest. The naturalist who aims at applying the deductions of physical ethnology to the determination of ethnic classification, cannot content himself with accepting such osteological evidence as presents itself to him, in the unquestioning spirit which may be permissible in other branches of natural history. The most

anthropoid of the inferior animals has not as yet been affirmed to cradle, bandage, or clothe its young; or to mummify or inter its dead. With rare exceptions, therefore, the comparative anatomist finds their skeletons in a uniform normal condition, and is justified in assigning a specific classification to distinctive cranial forms. But it is otherwise with the naturalist when he has man as the object of his study. Every scheme by which the ethnologist aims at systematising ethnic variations of cranial configuration, implies the recognition of national diversities in the form and proportions of the human head; but before attempting to determine their classification and significance, it is important to eliminate the various elements of extrinsic change. These then may be stated as follows:—

I. Undesigned changes of form superinduced in infancy by bandaging or other custom of head-dress; by the form of pillow or cradle-board; and by persistent adherence to any unvarying position in suckling and nursing.

II. Artificial deformation undesignedly resulting from the habitual carrying of burdens on the head, or by means of straps or bandages pressing on any part of the skull, when such is continued from early youth.

III. Artificial configuration designedly resulting from the application of mechanical pressure in infancy.

IV. Deformation resulting from posthumous compression, or any mechanical force brought into operation after death.

The first of those four classes has hitherto been overlooked, I believe; yet several remarkable instances have come under my own observation; and especially two examples of strikingly unsymmetrical heads, which appear to be clearly traceable to the fact that in both cases the mother was only able to suckle at one breast, and hence the infant skull while still in a soft and pliant condition, was constantly subjected to lateral compression only on one side. Even the persistent habit of carrying and laying to sleep on the same side, may permanently affect the form of the infant head.

In relation to the second class, my observations have been directed to the heads of Scottish fishwives and porters, and to Indian squaws, all of whom carry heavy burdens by means of a strap over the head or across the forehead, and to Edinburgh bakers, who carry their bread-boards on the crown of the head. But it seems doubtful if

the form of the skull is ever in any material degree affected, unless pressure is applied in very early life.

The third cause of artificial configuration is now universally recognised, though it is possible that in referring to the mummy of the Opas child preserved in the national collection at Lima, Dr. Tschudi ignores results produced even by this familiar source of cranial deformation; for the unsymmetrical form of the head figured by him is strongly suggestive of mechanical pressure, whether designedly or undesignedly applied during life, or arising solely from the rude processes of mummification. But where the more general custom of inhumation prevails another source of undesigned and posthumous compression comes into play, some results of which find striking illustration in the Indian skulls described above. To this neglected element of error in the ethnic value of cranial forms, attention was first directed by Dr. Thurnham, in describing the skull of a man about sixty years of age, found, in 1850, at the Village of Stone, near Aylesbury, Buckinghamshire, along with an iron spear-head and knife, the umbo of a shield, and other relics clearly recognisable as of the common forms and characters pertaining to Anglo-Saxon pagan sepulture. This skull attracted attention from features of an unusual and striking character. It is marked by distortion not only involving the most unsymmetrical deformity,—the whole right side of the skull having been thrust forward, and the left side proportionally thrown back, with great lateral protrusion of the right temporal and parietal bones,—but the articulating surface of the right temporal bone has been forced so much in advance of the left side as to render it no longer possible to replace the lower jaw, which retains its normal form. The remarkable distortion which this skull has undergone without the displacement or fracture of the bones of the calvarium, led at first to considerable difference of opinion as to the causes to which such singular malformation ought to be ascribed. But the impossibility of the essential vital functions of the jaws having been performed if the temporal bones had existed during life in the same unconformable relation to the lower jaw, left no room to doubt that the distortion had been produced subsequent to inhumation. Mr. J. B. Davis has accordingly devoted special consideration to the general subject of "posthumous distortion," when treating, in the "*Crania Britannica*" of various sources of abnormal cranial conformation; and refers to it as "another and distinct mode which will in future be required to be taken into consideration in all investigations

having reference to deformed crania." At the same time Mr. Davis accumulates additional evidence in confirmation of the opinions that the artificial distortion of the human head is by no means limited to the savage tribes of the New World; and discusses not only its practice among the ancient Macrocephali, including the received theory of Hippocrates that such artificial forms may be at length perpetuated by natural generation; but also "the extraordinary fact that the practice of distorting the skull in infancy is not yet extinct even in Europe." To this curious inquiry the attention of some of the distinguished Physiologists and Anatomists of France has been directed, and the result of the combined observations of MM. Foville and Gosse, along with those of M. Lunier, is to satisfy them that in different Departments of France, the practice of applying constricting coverings and bandages to the heads of infants still prevails; and that certain diversities of cranial configuration in some of the Provinces, and especially in Normandy, Gascony, Limousin and Brittany, are traceable to prevalent modes of infantile head-dress. It detracts considerably from the force of such conclusions, that the most remarkable examples produced by Dr. Foville, are derived from inmates of lunatic asylums; whereas the result of numerous independent observations on the Flathead tribes of the Pacific tends to prove that whatever may be the increase of mortality in infancy, produced by the barbarous practice of cranial deformation, the adults exhibit no mental inferiority to other Indians. On the contrary they are objects of dread to the neighbouring tribes among whom no such practice prevails, enslaving them, and retaining them in degrading servitude, while they rigorously exclude their slaves from the privilege of distorting the heads of their offspring; so that the normal head is with them the badge of servile inferiority. Mr. Davis has figured a distorted skull of an aged French woman in his collection, believed to have been the inmate of a lunatic asylum in one of the Southern Departments of France. It is produced in illustration of the most usual variety of deformation, denominated by MM. Foville and Gosse the *tête annulaire*: but though of somewhat brachycephalic proportions, there is nothing in the profile view, which is the only one given, calculated to suggest the idea of abnormal configuration.

From the various aspects which this craniological department of physical ethnology thus discloses to the inquirer, it becomes obvious that it is a greatly less simple element of classification than was as-

sumed to be the case by Retzius, Morton, or any of the earlier investigators of national forms of the human skull. To the *brachycephalic* and *dolichocephalic* types of Retzius, have now been added the *kumbecephalic*, the *platycephalic*, and the *acrocephalic*; and to the disturbing element of designed artificial compression, it is apparent we have also to add that of posthumous distortion, as another source of change, affecting alike the mature adult, even when old age has solidified the calvarium into an osseous chamber from which nearly every suture has disappeared, and the immature fœtus in which adhesion of the plates of the skull has scarcely begun. When more general attention has been directed to this element of abnormal cranial development, additional illustrative examples will no doubt be observed by craniologists; and the circumstances under which they are found will help to throw further light on the peculiar combination of causes tending to produce such results.

A POPULAR EXPOSITION OF THE MINERALS AND GEOLOGY OF CANADA.

(Continued from page 165.)

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PART III.

HOW ROCKS ARE CLASSIFIED AND DISTINGUISHED: WITH SPECIAL REFERENCE TO THE ROCKS OF CANADA.

In different localities, as a general rule, different kinds of rock occur. This must be familiar to the most casual observer. Thus, around the Falls of Niagara, and extending for miles across that section of the country, we find vast beds of limestone. About Hamilton, with other rocks, we have sandstone or freestone. At Toronto, our rock-masses consist of beds of clay and gravel, overlying grey and greenish shales. Near Collingwood, and again at Whitby, we observe dark-brown and highly bituminous shales, containing the impressions of trilobites in great numbers. At Kingston, we meet with limestone rocks differing from those at Niagara, and giving place, as we proceed north and east of the city, to beds of crystalline rock of

granitic aspect, geologically known as Gneiss. Some of the "Thousand Islands" consist of a very ancient sandstone. At Montreal, again, together with limestone, &c., we find in the picturesque Mountain, a dark and massive (or unstratified) rock, termed Trap, and more or less closely allied to the lavas of volcanic districts. These examples, without proceeding further, are sufficient to shew the diversity which prevails with regard to the rock-matters of comparatively neighbouring localities. But if we look, not to the mineral characters of these and other rocks, but to their respective origins or modes of formation—as evidenced by what is now going on in Nature in different parts of the world—it will be found that they fall naturally into three groups, as follows:

ERUPTIVE ROCKS.
METAMORPHIC ROCKS.
SEDIMENTARY ROCKS.

In each of the above groups, the included rocks are of various periods of formation, as explained in the Chronological Classification at the close of the present PART of our Essay. Before proceeding, however, to a discussion of this question, and in order more especially to prepare the general reader for a proper understanding of PART V, in which the geology of Canada first comes properly under review, it is necessary to consider these groups separately, and to enter into a few of their more practical details.

ERUPTIVE ROCKS.

The rocks of this division are of Igneous or of Aqueo-Igneous origin. That is to say, their present form is due to solidification from a fluid or plastic condition brought about by the agency of heat, assisted, in most (if not in all) cases, by that of steam or heated water. They have been formed beneath the earth's surface (whence the term "Endogenous" applied to them by Humboldt), and they have been driven up or erupted, at various geological epochs, through cracks and fissures in the overlying rocks. They are distinguished by never occurring in true strata, but always in the form of irregular, protruded masses, which sometimes present a columnar structure, or in that of broad overlying or intercalated sheets, or in straight veins called "dykes" (see further on), or in ordinary tortuous veins. Secondly, by never exhibiting in their structure the marks of a sedi-

mentary origin, such as rolled stones, grains of sand, &c. And, thirdly, by never containing organic remains.

Where eruptive rocks traverse or lie in contact with other formations, these latter are usually found to be more or less altered, as though by the agency of heat, near the points of contact. Coal-beds are thus for some distance often burnt into cinder or converted into coke; soft limestones changed into crystalline marbles; sandstones altered in colour, hardened, and changed into quartz-rock, and so forth.

These rocks are arranged by Sir Charles Lyell in two broad divisions: Volcanic and Plutonic rocks; but it is impossible to draw a distinct line of demarcation between the two. Granite and syenite, for example, belong to the Plutonic series; but certain granitic trachytes connect the granites with the volcanic rocks; and in like manner, certain greenstones merge on the one hand into syenite, and on the other (the distinction between augite and hornblende being now essentially broken down) into augitic lavas. This equally affects the sub-division into Volcanic, Trappean, and Granitic rocks, adopted by other observers. I would therefore propose, as an arrangement of convenience, the distribution of the Eruptive rocks into the six following groups:—1. Lavas; 2. Obsidians; 3. Trachytes; 4. Traps and Greenstones; 5. Serpentines; 6. Granites. On each of these it is necessary to make a few observations.

1. *Lavas.*—These comprise the actual rock-matters which issue in a molten condition from volcanic vents. During the solidification of lava currents, dense volumes of steam are emitted from the cooling mass. Lavas are of two general kinds: feldspathic, and feldspatho-augitic. The first, and by far the most common of the two, are composed essentially of feldspar, and are mostly of a dark or light grey colour. They pass into trachytes. The second are composed essentially of feldspar and augite,* are dark green or almost black in colour, and undistinguishable, except by their actual conditions of occurrence, from many traps or basalts. As examples of these rocks are not found in Canada, we need not describe their varieties, or enter into further particulars respecting their conditions of occurrence.

2. *Obsidians.*—The rocks grouped under this division, are lavas, or other igneous products, in a vitreous or glassy state. They are entirely feldspathic in composition. When in connexion with volcanic

* See descriptions of these minerals in Part II. of this Essay.

cones, and of a grey, black, green, brown, or varied colour, and breaking into sharp-edged fragments, they constitute the variety properly called Obsidian. Pearlstone is a closely-related variety, containing small spherical concretions of a more or less pearly aspect. Another form, of a black, dull-red, green, or dark colour, and of a somewhat pitch-like aspect, is called Pitchstone or Retinite. This latter is stated by Sir. W. E. Logan to occur on the north shores of Lakes Huron and Superior. It should be observed, however, that the term Retinite is applied by some authors to a bituminous substance of a very different character.

3. *Trachytes.*—These rocks have normally a harsh, rough texture (whence their name from τραχυς), and a white or light colour; and they are either entirely or essentially feldspathic in composition. They offer three principal varieties, exclusive of Pumice, which may be placed either here or amongst the lavas. These varieties merge, however, into one another. They comprise: common Trachyte and compact Trachyte, composed normally of Orthoclase or potash feldspar, and Granitic Trachyte, a rock of a granitic structure, made up of orthoclase feldspar, with small crystals or grains of hornblende, augite, or mica. Common Trachyte occurs chiefly in active or extinct volcanic districts. It often contains crystals of glassy feldspar, and sometimes scales and crystals of mica, &c. Occasionally, also, free silica or quartz is found in it, although accidentally, as it were, and only in small quantity. Compact Trachyte, or feldspar trap, as this variety has been termed, is found in broad straight veins or "dykes," of a white colour, traversing the Montreal mountain, and occurring also (of a pale-reddish colour) at Chambly, &c. Granitic Trachyte (in some instances closely resembling granite, but differing from that rock by the absence of quartz) forms the eruptive mountains of Brome, Shefford, Yamaska, Rougemont, Belœil, Mount Johnson, &c., of the Eastern Townships. These granitic trachytes (or granitic diorites, as they might be termed with equal justice, see below) differ a good deal in colour and appearance, according to the amount of hornblende, mica, &c., which they contain. Like the compact trachyte of Lachine and Chambly, they are sometimes "porphyritic"—containing more or less distinct and large crystals of feldspar. (See Mr. Hunt's Report for 1856, and that for 1858; also this Journal, Vol. V. page 426.) Many of the trachytes of these localities are in a partially altered state, effervescing in acids from the presence of

carbonates. By weathering, also, they become reddish-brown, dull-white, &c., and tend to decompose into clay-stone or "Domite." This latter term is derived from the partially-decomposed trachytes of the Puy-de-Dôme, in central France.

4. *Traps and Greenstones.*—The rocks of this group chiefly affect the form of intrusive dykes (*i.e.* broad and more or less straight or simply-forking veins (as in fig. 52), or otherwise occur in overlying, intercalated, and irregular masses, which frequently present a columnar structure. The traps proper, or dolerites, are always of a black or dark colour, and consist essentially of a more or less uniform mixture of lime feldspar (or soda feldspar) and augite, with in general a mixture of zeolitic minerals and magnetic iron-ore. The green-stones or diorites, consist normally of soda feldspar (or of a feldspathic mixture) and hornblende, and have usually a more or less decided green colour. It is sometimes impossible, however, to distinguish greenstone from trap, more especially as late researches have shewn that augite and hornblende possess the same atomic composition. Hence the two rocks should properly be classed together.

52.

When the rock is of a black or dark colour, more or less compact, and amorphous in form, it is termed *Trap*. This variety occurs in numerous dykes on the north shore of Lake Huron and on the shores of Lake Superior. When a trap rock contains distinctly imbedded crystals of any mineral distributed through its mass, the name of this mineral may be conveniently attached to it. Thus, the Montreal mountain consists principally of *Augitic Trap*. The same variety, containing olivine* in addition, forms the mountains of Montarville and Rougemont. When the rock assumes a columnar or basaltiform structure, it becomes *Basalt*. This variety does not appear to be common in Canada, but it occurs, here and there, on the north shore of Lake Superior, and probably in other parts of the Province. When, again, as frequently happens, a trap or basalt is of a more or

* The student should refer to the descriptions of these minerals in the preceding Part of this Essay. See the Index, pages 162-4, of this volume.

less coarsely-vesicular structure, or contains oval or other shaped cavities usually filled with calc-spar, amethyst-quartz, agates, various zeolites, &c., the rock is called an *Amygdaloid*, or *Amygdaloidal Trap*. Numerous examples occur in the northern district of Lakes Huron and Superior; and the agates of Michipicoten Island and other localities of this region, are derived from the disintegration and washing away of the amygdaloidal traps in which they were originally enclosed.

The greenstones, or diorites, occur under the same conditions as the traps. Compact and amygdaloidal varieties are common about Lake Huron, &c.; and Sir William Logan, in his Report for 1853, has described the occurrence of a columnar greenstone in the Township of Grenville, Argenteuil Co., C. E. In some greenstones, the component minerals, feldspar and hornblende, become individually perceptible. This variety might be called, indifferently, a granitic trachyte, or a granitic diorite, and placed in either of these groups.* A latitude of this kind, in the classification of these eruptive rocks, is unavoidable. Their frequent transitions and irregularities of composition, render the drawing of very definite lines a complete impossibility. For this reason, the attempt to frame a number of so-called species out of the trappean and other eruptive rocks, and to bestow upon these distinct names, becomes both useless and unphilosophical.

Finally, it may be observed, that many varieties of trap and greenstone are very subject to decomposition, yielding soils of much fertility. By weathering, they become mostly dull-grey, brown, or red.

5. *Serpentines.*—The rocks of this series are essentially hydrated silicates of magnesia. They consist, strictly, of varieties of one mineral substance, *serpentine*. (See above, p. 159.) Their colour is somewhat variable, but chiefly green, brown, reddish, or greenish-grey—these tints frequently occurring together in veins and patches. They are more or less soft and sectile, and somewhat granular or compact in structure; forming dykes and irregular masses, although comparatively of rare occurrence as eruptive rocks. Most serpentines are found in large beds, and are evidently altered sedimentary deposits or metamorphic rocks, but undoubted instances of eruptive serpen-

* If minute distinctions be advisable, the term *granitic trachyte* might be restricted to such of these rocks as contain orthoclase or potash feldspar, whilst those in which triclinic feldspars are present might be called granitic diorites; but it is not always possible to carry out these distinctions.

tines occur in Tuscany and elsewhere. In some cases, however, massive serpentines of this kind may have been derived from the alteration of trap and greenstone rocks. The serpentines which occur in Canada, are considered to belong entirely to the Metamorphic series, and are described, consequently, under that division.

6. *Granites.*—These rocks possess normally a crystalline aspect and strongly-marked granular structure, whence their name. They are also especially characterized by the presence of free silica, or quartz, as an essential component. They occur in irregular, unstratified masses (often breaking through and tilting up the surrounding rocks), or in tortuous branching veins. Some are of very ancient date; whilst others are of comparatively recent formation, at least in a geological point of view. Hence the obvious objections which apply to the use of the terms "Primary" or "Primitive," often bestowed indiscriminately on all granitic rocks, as well as on strata of metamorphic origin—these latter, like the granites, and all other rocks, indeed, being of various periods of formation. Under a subsequent section, it will be shewn that the age of a rock is in no way indicated by mineral characters or composition. Where two granitic or other veins intersect, the intersected vein (which is generally displaced moreover, one portion being thrown up or down) will, of course, be the older of the two. In like manner, where a granitic or other eruptive rock underlies another rock of any kind, this latter will necessarily be the older of the two if veins pass into it, or if it be altered by chemical or mechanical action.

The more important rocks of this section, comprise granite and syenite

Granite, properly so-called, is composed of three minerals: Quartz, Feldspar, and Mica, full descriptions of which are given in Part II. of this Essay. The quartz is colourless and vitreous; the feldspar, usually white or flesh-red, with smooth and somewhat pearly cleavage planes; the mica, white, grey, brown, black, or sometimes green, in scales, specks, or foliæ, of a pearly-metallic aspect. In the fine-grained granites, these component minerals become so intimately blended as to be individually undistinguishable. When crystals of feldspar are distinctly imbedded in a fine or coarse-grained granitic mass, a variety termed *Porphyry*, or better, *Porphyritic Granite*, is produced. The term "porphyry" (from πορφυρα) as the name would indicate, was originally applied to rocks of this kind in which

the base or imbedded crystals were of a red colour; but it is now conventionally bestowed on all rocks containing distinct crystals of feldspar or other minerals. Thus, we have porphyritic granite, porphyritic trachyte, &c. Occasionally, the mica in granite is replaced by talc, giving rise to *Talcose Granite*. Sometimes, also, the mica dies out, when a granitic mixture of quartz and feldspar results. This has been called *Pegmatite*.

Examples of intrusive granite occur amongst the strata of the Laurentian and Huronian series in the Lake Superior region and on the north shore of Lake Huron, and elsewhere, but apparently in no very prominent masses; although veins composed of quartz and feldspar, or of quartz alone, are of exceedingly common occurrence throughout the entire area occupied by the gneissoid Laurentian rocks. Fig. 53 is a sketch of some quartzo-feldspathic veins in gneiss, near the right bank of the river Severn, C. W. In the more modern metamorphic district south of the St. Lawrence, however, granitic masses (which appear to pass into granitic trachytes or diorites) constitute the Megantic mountains, and occur also in force in Hereford, Stanstead, and other townships of that district. (The localities cited by Sir William Logan, in his *Esquisse Géologique du Canada*, comprise: Stanstead, Barnston, Hereford, Marston, Megantic Mountains, Weedon, Winslow, Stafford, and Lambton.)

53.

Syenite.—This eruptive rock is composed of a granitic mixture of quartz, feldspar, and hornblende, the latter being green or black in colour. When mica is also present, the rock becomes *syenitic granite;* and when the quartz grows gradually less and less abundant, there is a transition into granitic diorite or greenstone. Some syenites are of a red colour from the prevalence of red feldspar, and many syenites are porphyritic. Intrusive syenite occurs amongst the Laurentian rocks in various localities. An enormous mass of this rock, covering an area of thirty square miles, is cited by Sir William Logan, as occurring in the townships of Grenville, Chatham, and Wentworth, in Argenteuil County, on the Ottawa.

Granitic rocks frequently become converted, by the decomposition of the feldspar, into white or light-coloured clays, largely used, under the name of *Kaolin*, in the manufacture of porcelain.

METAMORPHIC ROCKS.

The rocks thus named are *stratified rocks* of a more or less granitic, trappean, or crystalline aspect, and of various periods of formation. It has been already stated, that where a dyke, vein, or erupted mass of trap or granite traverses other rocks, these latter are very generally altered in character, and, to some extent, in composition. Earthy or common limestones are thus near the points of contact transformed, in some localities, into hard marbles or crystalline limestones, and are frequently filled with crystals of garnet, tourmaline, hornblende, and other minerals. In like manner, sandstones are changed in colour and texture, and are often converted into quartz-rock; whilst clay-slates are transformed into gneiss, mica-slate, talc-slate, and other so-called "crystalline schists." Although analogous effects are sometimes produced artificially in the walls of smelting furnaces, these metamorphic results, as seen in Nature, are probably due not so much to the simple agency of heat, as to that of various gases and heated vapours accompanying the protrusion of the eruptive mass. In many localities, on the other hand, these effects appear to have been produced without the direct intervention of eruptive rocks, in which case the alteration or metamorphism has probably proceeded from steam and gases transmitted from below, from heated chemical solutions percolating the altered rocks, or from other causes more or less immediately dependent on the presence of subterraneous heat. Be this as it may, it is now universally conceded that the crystalline stratified rocks are altered sedimentary deposits—sandstones, slates, limestones, and so forth. In Canada (as explained more fully in PART V.) there are two distinct series of metamorphic rocks. One, including the Laurentian and in part the Huronian series, belongs to the Azoic Age, and constitutes the most ancient group of rocks of this continent. The Laurentian series is made up of vast beds of gneiss, crystalline limestone, and other rocks described below, and it extends over almost the entire northern portion of the Province. For geographical limits, geological and other characters, see PART V. of this Essay. The Huronian rocks of the north shore of Lake Huron, &c., are also in part metamorphic, and include, amongst other more or less altered deposits, some remarkable quartz and jasper conglomerates. The other series of metamorphic strata are of more recent, although still of ancient, date. They belong to the Silurian and

Devonian periods of the Palæozoic Age (see the close of this PART, and also PART V.), and they occur in the Eastern Townships and adjoining district south of the St. Lawrence. On the edge of this latter metamorphic region, the passage of the unaltered into the altered strata may be traced in many localities.

The following are the more important metamorphic rocks of Canadian occurrence:

Gneiss.—This crystalline rock only differs (lithologically) from granite and syenite by occurring in beds or strata. It is of two kinds: *micaceous or ordinary gneiss,* and *syenitic* or *hornblendic gneiss.* The former consists of quartz, feldspar, and mica; the latter, of quartz, feldspar, and hornblende. When the mica or the hornblende predominates, and the feldspar diminishes in quantity, these pass into mica slate and hornblende slate (or hornblende rock), respectively. Gneissoid rocks of this kind prevail everywhere amongst the Laurentian strata, and sometimes contain garnets and other minerals. They constitute, moreover, the greater number of the boulders scattered so abundantly over the surface of Canada (see PART V.) Gneiss may generally be distinguished from granite, even in hand specimens, by its striped or banded aspect, the colours being usually various shades of grey and red.

Mica Slate.—This rock consists normally of quartz and mica. It is more or less fissile or schistose, somewhat pearly or silvery in aspect, and usually of a white or greyish colour, though sometimes almost black. It passes into gneiss on the one hand, and into clay-slate on the other. It is often called *mica schist.* It occurs more or less, throughout the Laurentian formation (Lake Huron, north shore; French River; Baie St. Paul, &c.)

Feldspar Rock.—This is a mixture of various feldspars. It is usually of a greenish-blue or slightly-shaded white colour; or, otherwise, pale reddish, greenish, brownish-yellow, &c. Fine-grained and porphyritic varieties occur. In the latter, the enclosed, grey, cleaveable masses sometimes present the green and other reflections peculiar to the characteristic examples of labradorite. (See Part II.) At other times, these enclosed masses or crystals are of a red, lavender-blue, or brownish colour. Hypersthene, also, in laminar masses of a brown sub-metallic tint, is frequently present, forming the variety sometimes called *Hypersthene Rock.* Mica, augite, garnet, titaniferous iron, and some other minerals, are likewise of occasional occur-

rence in those feldspathic beds. The Laurentian deposits of the counties of Montmorenci (below Quebec), Terrebonne, &c., afford good examples of Feldspar Rock. (See Analyses, &c., in Mr. Hunt's Report for 1854.)

Hornblende Rock.—This rock, frequently of a schistose structure, and then called "Hornblende Slate," or "Hornblende Schist," is normally a compound of quartz and hornblende. Very often, however, it is nothing more than a highly hornblendic variety of syenitic gneiss. It has a dark-green or black colour, and frequently contains garnets in sharply-defined crystals. Hornblende rock occurs in some abundance amongst the Laurentian strata, as in the counties of Lanark, Frontenac, Lennox, &c. Also in the valley of the Bonne-chère (Mr. Murray); on French River, Lake Huron; and at other localities in which these strata prevail. It occurs likewise amongst the more modern metamorphic series south of the St. Lawrence. In the latter district, a rock made up of greyish-green actynolite, in interlacing fibres, is found in Beauce County. (Mr. Hunt's Report for 1856.)

Wollastonite Rock.—Wollastonite, or tabular spar, is a mineral closely related to augite. (See its description in Part II. above, Vol. V. page 528.) Mixed with the latter species, it forms subordinate beds, associated with crystalline limestones, amongst the Laurentian strata of certain localities.

Garnet Rock.—Beds of light-coloured massive garnet occur amongst the metamorphic series of the Eastern Townships. (Mr. Hunt's Report for 1856.) Certain subordinate beds, made up in chief part of granular garnets of a red colour, are found likewise in connexion with crystalline limestone amongst the Laurentian strata, as in the County of Argenteuil, and elsewhere. (See Part II. Vol. V. p. 524; and Sir W. E. Logan's Report for 1856.) Mr. Richardson, in his Report for 1857, describes also the occurrence of garnet rock in association with micaceous schists, at Baie St. Paul.

Chlorite Slate.—This rock, of a greenish colour, and normally of a schistose structure, occurs both amongst the Laurentian and Huronian series, and the more modern metamorphic strata of the Eastern Townships. All of these chlorite-slates contain a certain amount of water. In the Eastern Townships they pass into more or less compact "potstones." (See Part II. above, page 160.)

Talc Slate.—The rock thus named occurs principally in the Eastern

Townships, forming both semi-crystalline and compact or steatitic beds. (See Part II. above, page 158.) These are of a light-green, silvery-white, or greenish-grey colour. Some of the beds of the Laurentian series, as in the neighbourhood of Marmora, &c., are also somewhat talcose, or contain interstratified layers of talc. Talcose slates occur likewise amongst the Huronian strata.

Serpentine.—Serpentine rock, or Ophiolite, occurs in extensive beds amongst the metamorphic strata of the Eastern Townships. Its mineralogical characters have been already given (*ante*, page 159), but the rock, it may be stated here, is essentially a hydrated silicate of magnesia, more or less sectile, and of various colours, but chiefly dark-green, greenish-grey, or greenish-white, often with red or bluish veins, or variously mottled. It is very commonly mixed with carbonate of lime or dolomite, forming serpentine-marbles of green, chocolate-brown, and other colours. In Bolton, Ham, and other townships of this district, beds of chromic iron-ore are associated with these serpentine rocks; and a bed of magnetic and titaniferous ore, fifty feet in thickness, occurs in the serpentine of Beauce. A large development of serpentine rock, fit for economic purposes, occurs also with chromic iron-ore at Mount Albert, in Gaspé. According to Mr. Richardson (Report for 1850), the rock-exposure at this locality presents vertical cliffs of several hundred feet in height, and covers an area of not less than ten square miles.

Diallage Rock.—This rock consists principally of the mineral called diallage (see page 159, above), or of diallage and chlorite. It has a clear green or pale-bronze colour, is more or less fissile, and occurs in association with the serpentines of the Eastern Townships, to which, also, it is very closely allied.

Quartz Rock, or Quartzite.—The rock thus named appears to have been formed by the alteration of sandstone strata It has a more or less vitreous aspect on newly-fractured surfaces, is very hard, and is either colourless, or yellowish, greenish, pale red, brownish, &c. It occurs abundantly amongst the Huronian rocks of the north shores of Lakes Huron and Superior; and also amongst the Laurentian strata of many localities, as at St. Jérome and elsewhere. A remarkable quartz-conglomerate, containing pebbles of red jasper and white quartz in a colourless or pale-yellowish quartzose base, is met with in the Huronian formation of the Bruce Mines district; and other conglomerates of a somewhat similar character occur in the Laurentian

series. These shew clearly the metamorphic origin of the rocks in question.

Crystalline Limestone.—This rock consists of carbonate of lime in a semi-crystalline condition. It is usually white or pale reddish, and is sometimes veined or clouded with yellow, blue, green, and other coloured streaks and patches. Its structure is fine or coarse granular, somewhat resembling that of loaf sugar, whence the term "saccharoidal limestone," bestowed on this rock. Crystalline limestone occurs in beds amongst the metamorphic strata of the Laurentian and Huronian series, and also amongst those of the more modern series south of the St. Lawrence. The serpentine marbles of the Eastern Townships have already been alluded to. These limestone bands are not only of economic employment,—many yielding marbles of superior quality,—but, when occurring amongst the gneissoid rocks of the Laurentian series, they impart fertility to the otherwise too generally unproductive soil. Where the gneiss rocks are uncovered by Drift deposits, it is only indeed in connexion with the crystalline limestones or beds of feldspar-rock, that soils of any depth or fertility can be expected to occur. It is perhaps needless to observe, after what has been stated in PART II. of this Essay, that crystalline limestone may be distinguished from quartz and feldspar by being easily scratched by a knife, and also by dissolving with effervescence in diluted acids. For special localities of Canadian marbles, see PART V.

Crystalline Dolomite and Magnesite.—In external characters and conditions of occurrence, the crystalline dolomites resemble the ordinary crystalline limestones, but consist of carbonate of lime and carbonate of magnesia. A fine saccharoidal variety occurs amongst the Laurentian strata of Lake Mazinaw. Beds of Magnesite, consisting of carbonate of magnesia mixed more or less with feldspathic or quartzose matters, occur amongst the altered Silurian strata of the Eastern Townships. These beds are chiefly white, greenish, or bluish-grey in colour, and generally resemble crystalline limestone. Some, by weathering, become reddish-brown. (T. Sterry Hunt, Report for 1856.)

SEDIMENTARY ROCKS.

The rocks of this division make up by far the greater portion of the Earth's surface. Having been formed by the agency of water,

they are often called *Aqueous Rocks*. They are chiefly of mechanical formation, consisting of muddy, sandy, and other sediments, collected by the mechanical action of water, and subsequently consolidated by processes described a few pages further on. Various limestones, however, and certain other rock matters of this division, are of chemical origin, or, in other words, have been deposited from waters in which their materials were chemically dissolved.

These sedimentary or aqueous rocks are characterized by always occurring in beds or strata (with the occasional exception of certain irregularly-heaped masses of drift materials); secondly, by exhibiting in many instances, a more or less clearly-marked detrital or sedimentary structure; and thirdly, by often containing organic remains. These latter, comprising shells, bones, leaf-impressions, &c. (see PART IV.), are the fossilized parts of animals and plants which lived upon the Earth, or in its waters, during the periods in which these rocks were under process of formation, as indicated below.

The sedimentary rocks may be conveniently discussed under the following heads: Composition or mineral characters; Modes of formation; Changes to which they have been subjected after deposition.

(1) *Composition of Sedimentary Rocks.*—Viewed as to their composition, these rocks comprise:

- Sandstones, sands, and gravels—or arenaceous rocks.
- Clays and clay-slates—or argillaceous rocks.
- Limestones and Dolomites—or calcareous rocks.
- Conglomerates and Breccias: rocks of mixed composition (see below).
- Trap tufas: stratified deposits formed out of materials derived from the denudation of trap and greenstone rocks.
- Rock matters of purely organic origin, as coal, &c.

To these may be added a few other substances of subordinate occurrence, as gypsum and rock-salt.

Sandstones are nothing more than beds of consolidated sand. They are of various colours, but chiefly white, or dull shades of yellow, red, brown, or green. The harder and purer kinds, as some examples of our "Potsdam sandstone," are called *quartzose sandstones*. In other kinds, a certain amount of carbonate of lime is present, cementing together the component grains of sand, and forming calcareous sandstones. For special Canadian localities of these and other rocks

mentioned under this division, consult PART V. Certain siliceous rocks, called "tripoli" and "infusorial marls," are formed entirely of the tests of diatoms and other infusoria. (See Part IV.)

Clay Slates are merely consolidated clays. They have a fissile structure, and are chiefly of a grey, greenish, brown, or black colour. Clays are also of various colours, as white, greenish, yellowish, bluish, black, and red. Those which contain little or no iron, burn white, and yield consequently white bricks. Many clays are highly calcareous; others, bituminous, &c. *Note.*—The term *shale* is often applied to fissile consolidated clays; but this term is applied equally to fissile or slaty limestones and sandstones. When the term is used, therefore, the kind of shale should also be signified: as *an argillaceous shale, an arenaceous shale,* and so forth. *Bituminous shales,* as regards their mineral base, may be also arenaceous, calcareous, &c.

Limestones and *Dolomites* are principally, perhaps, of chemical formation. Water containing free carbonic acid (derived from decaying vegetable matters, &c.) dissolves a certain amount of carbonate of lime, but the bicarbonate, thus formed, is easily decomposed by various natural agencies, even by mere exposure to the atmosphere, and a precipitation of calcareous matter takes place. In this manner, calcareous tufas (so common in many of our swamps, streams, &c.), together with stalactites and stalagmites, are produced; and similar processes, acting on a larger scale, may have given rise to extensive depositions of limestone strata in ancient seas and lakes. Some limestones, again, are formed almost wholly of the calcareous shells or tests of crinoids, foraminifera, and other organisms (see PART IV.); but others are, undoubtedly, mechanical or rock deposits, derived from the wasting of coral reefs and older limestone formations. Limestones consist of carbonate of lime, more or less pure; dolomites, of carbonate of lime and carbonate of magnesia in equal atomic proportions; and dolomitic limestones of these two carbonates in other proportions, the lime carbonate generally predominating. Dolomites and dolomitic limestones appear in many cases to have been simple chemical precipitates, and, in others, to have originated from the alteration of limestone rocks by the action of soluble magnesian salts. These calcareous rocks are of various colours: grey, white, black, yellowish, &c. Their texture is sometimes very close and uniform. At other times, the stone is made up of small spherical concretions, when the texture is said to be "oolitic." Oolitic

limestones are of all geological ages. Some limestones, again, are of an earthy texture: the well-known chalk of Europe is an example; also our own "calcareous tufa," or "shell marl." Many of the dark limestones, as those of Niagara, &c., are more or less bituminous. All effervesce in acids; but the dolomites produce merely a feeble effervesence unless the acid be heated. Limestones which contain from 15 to 25 per cent. of argillaceous matter in intimate admixture, yield hydraulic or water lime. Beds of this kind occur at Thorold, Cayuga, Loughboro', Kingston, Hull, Quebec, and other localities. (See PART V.)

Conglomerates consist of rounded stones or masses of quartz, sandstone, &c., cemented together, or imbedded in a paste of finer sandstone, limestone, or other rock substance. The imbedded masses are sometimes of great size, a fine example of which may be seen at Quebec. Conglomerates, both altered and unaltered, are abundant amongst the Huronian rocks.

Breccias consist of angular masses or fragments of rock, cemented together, chiefly of some kind of limestone. Whilst conglomerates frequently consist of materials brought from a greater or less distance, true breccias are necessarily formed in place. Examples of calcareous breccias occur in the Eastern Townships. Also with imbedded trap and slate fragments, near the Bruce Mines, Lake Huron, and elsewhere.

(2) *Formation of Sedimentary Rocks.*—The manner in which the ordinary sedimentary rocks, sandstones, shales, &c., have been formed, or built up as it were, is rendered clear by the observation of certain natural processes still in action. We find for example, at the present day, that sediments of various kinds are constantly being carried down by streams and rivers into lakes and seas, and are there deposited. We find, moreover, that the cliffs of many sea (and lake) coasts are being continually abraded and washed away by the action of the waves. Observation shews also, that the sedimentary matters thus obtained, are always deposited or arranged in regular layers or beds, and that they frequently enclose shells and sea-weeds, together with bones and leaves, drifted from the land, and other organic bodies. Hence it is now universally admitted, that, with the exception of certain limestones and dolomites, beds of rock-salt, gypsum, coal, and other chemical or organic deposits of small extent, all the sedimentary rocks have been formed directly out of previously-existing rock-masses,

by the wearing away or destruction of these; and secondly, that they have all been formed or deposited under water.

In pursuance of this inquiry, consequently, we have to consider, first, the origin or derivation of the sediments of which these rocks are made up; and, secondly, the processes by which the consolidation of the sediments into rock, properly so-called, was effected.

The sediments of which these rocks originally consisted, were derived from previously-existing rocks, by decomposing atmospheric agencies,—rain, frost, and so forth; by the action of streams and rivers on their beds; and by the destructive action of the waves and breakers of the sea.

Action of the Atmosphere.—All rocks, even the most solid, are constantly undergoing decomposition and decay. The exposed face of a rock of any kind, for example, soon changes colour, and becomes in general more porous than the other portions of the rock. This effect is technically termed "weathering." Its action gives rise to the production of soils, and frequently causes the fossils contained in the rock to stand out in relief, these being in many cases less easily decomposed than the mass of the rock itself. Every shower of rain that falls, takes part in this decomposing or disintegrating action, and carries off something, in solution or suspension, to lower levels—*id est*, into streams, lakes, and seas. Frost, and, in certain districts, carbonic acid and other gases issuing through crevices in the rocks, assist this destructive process.

Action of Streams and Rivers.—The action of streams and rivers in wearing their channels is both chemical and mechanical. Calcareous river-beds are wasted bit by bit by the dissolving power of the water, especially during the autumnal season, when dead leaves and other decaying vegetable matters yield the water a large supply of carbonic acid. On the other hand, a mechanical waste is also very generally taking place to a greater or less extent: and thus numerous rivers are continually cutting back their beds, and forming ravines. It is thought by many geologists, that the Falls of the Niagara River have in this manner gradually receded from the escarpment at Queenston to their present site; and there is scarcely a river, or small stream indeed, in any part of Canada, that does not exhibit in its banks indications of erosive action. Where streams wind through the sands and gravels of our Drift deposits, as in the neighbourhood of Toronto, to cite a single amongst so many instances, examples of this action are especially apparent. The River Don, it is said, during a three

days' freshet, about fifty years ago, greatly enlarged its channel, and added much in places, to the steepness of its banks. The amount of detrital matters borne down by some rivers to the sea, is, at first thought, almost incredible. This is well shown by the formation of deltas. The delta of the Mississippi, on this continent, for example, like all other deltas, is formed almost entirely out of the sandy and other matters brought down by the stream. On entering the sea, the velocity of the river is necessarily checked, and the sediments are thus thrown down. Much of the coarser matter is indeed deposited on the bed of the river itself, raising this, and compelling the formation of artificial banks, or levées, to prevent inundations. Finally, as a well-known illustration of the immense amount of sedimentary matters borne seawards by certain rivers, the case of the Ganges, as described so fully by Sir Charles Lyell, in his "Principles of Geology," may be here cited. That river, it has been demonstrated, by actual observation and experiment, conveys annually to the sea an amount of matter that would outweigh sixty solid pyramids of granite, each, like the largest of the Egyptian pyramids, covering eleven acres at its base, and standing 500 feet in height. A considerable quantity of sediment is also produced by the slow movements of glaciers in Alpine and other districts in which these remarkable ice-rivers prevail. The glacier of the Aar, which covers with its tributaries an area of only six or seven square miles, thus furnishes daily, according to some recent researches of M. Collomb, at least 100 cubic yards of sand. This is carried off by its terminal stream or torrent.

Action of the Sea (and of large bodies of Water generally.)—Vast in amount as are the sediments collected by rivers, they are far surpassed by the accumulation of detrital matters obtained by the waves and breakers of the sea. All who have resided for any length of time on an exposed and rocky coast, must be well aware of the destructive action of the waves. The cliffs subjected to this action, gradually become undermined and hollowed out; and thus large masses of rock are brought down by their own weight. These, sooner or later, are broken up, and spread in the form of sediment along the shore, or over the sea-bottom. On some coasts, the amount of land destroyed in this manner almost exceeds belief.* On some

* It would obviously be out of place in an Essay like the present, to enlarge on this point. The reader unfamiliar with geological details of this character, should consult, more especially, Lyell's *Principles of Geology*, and also the *Cours Élémentaire* of the late Alcide d'Orbigny.

arts of the eastern shores of England, and the opposite or western shores of France, for example, the sea has thus carried off, within the present century, from fifty to over one hundred yards of coast—measured backwards from the shore-line—and for a distance of many miles. Grave-yards, shewn by maps of no ancient date to have been located at considerable distances from the sea, have become exposed upon the cliff-faces; and forts on the French coast, built by the First Napoleon, at two hundred metres and upwards from the edge of the cliff, now lie in ruins on the beach, or have altogether disappeared. These localities are mentioned as being more especially known to the writer; but in all parts of the world examples may be found of the same destructive process. In the clay and sandy bluffs of our own lakes, as at Scarbro' Heights on Lake Ontario, and elsewhere, the effects of this action may be equally studied.

On a subsequent page it will be shewn that these results of denudation, however striking in themselves, were greatly surpassed by those of former geological epochs; but confining our view at present to modern effects only, it must be evident to all that an enormous amount of sedimentary matter is annually, or even daily, under process of accumulation. The question then arises as to what becomes of this. The reply is obvious. The detrital matter thus obtained, is deposited in lakes or at river-mouths, or along the sea-shore, or over the sea-bed —contributing day by day to the formation of new rocks. In other words, existing rock-masses, worn down by atmospheric agencies, by streams and rivers, and the action of the sea, supply the materials for other and, of course, newer deposits. And thus, when we look upon a piece of stone derived from one of these, we may picture to ourselves the scene of its formation, and, with the poet, hear—

> The moaning of the homeless sea,
>   The sound of streams that swift or slow
>   Draw down Æonian hills, and sow
> The dust of continents to be—

—for truly, is it the dust of new continents that is thus being deposited, atom by atom, by these slow but continued processes.

All sediments diffused through deep or quiet water, arrange themselves, under general conditions, in horizontal or nearly horizontal beds: the latter, if deposited on gently-sloping shores. Professor H. D. Rogers, in his recently-published Report on the Geology of Pennsylvania, contests to some extent this usually-received view, and

maintains that certain inclined strata of mechanical formation were originally of inclined deposition. This may be true under local or exceptional, but certainly not under general, conditions. (See proofs, further on.) Where, however, sands and gravels are thrown down by currents and running streams, an oblique arrangement commonly takes place; but this is more or less confined to the subordinate layers of which the larger beds consist, as shewn in the annexed figure. The inclined layers have sometimes different degrees of inclination, and even dip (in different beds of the same strata) in opposite directions, indicating changes in the tidal or other currents by which they were thrown down. This inclined arrangement is termed "false bedding," or "oblique stratification." It may be seen in some of the more ancient, and also in some of the more modern deposits of this continent, as in the Potsdam Sandstone of the south shore of Lake Superior, and in the Drift gravels of many parts of Canada.

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Having thus rapidly traced out the formation of the mechanically-formed sedimentary rocks up to their deposition in the state of detrital matter on the beds of seas, lakes, or estuaries, we have now to inquire how these accumulations of mud, sand, &c., become hardened into rock, properly so-called.

Consolidation of Sediments.—Most sediments hold within themselves the elements of their own consolidation, in the form of particles of calcareous or ferruginous matter, which act upon the other substances in the manner of a cement. Frequently, also, a large amount of calcareous matter is derived from the decomposition or solution of imbedded shells and other organic remains made up of carbonate of lime. In the majority of strata, and in sandstones more especially, merely casts or shell-impressions are thus left, in place of the originally imbedded shells. Masses of solid conglomerate are daily under process of formation, in places where springs containing calcareous or ferruginous matter infiltrate through the gravels and pebble-beds of our Drift deposits. Many thermal springs (and even ordinary river-water) also contain considerable quantities of silica in solution; and there is reason to believe that in former periods of the Earth's history, springs of this kind must have prevailed to a very great extent. These flowing into seas and lakes where sediments were under process of deposition, must also have lent their agency towards the

consolidation of such deposits. Many of our Canadian limestones, it may be observed—as those, more especially, which occur at the base of the great Trenton group (see PART V.)—are highly siliceous.

The enormous pressure exerted upon low-lying sedimentary beds by those above them, must likewise have been sufficient in many instances to have effected consolidation. Loose materials, as graphite powder used in the manufacture of the so-called "black lead" pencils, are thus rendered solid by artificial pressure. Spongy platinum, again, by the same process, is converted into the solid metal.

The heat transmitted in earlier periods from subterranean depths, or generated amongst low-lying sediments by natural causes, may also have been concerned in the work of consolidating the originally loose materials of stratified rocks. It may be remarked, likewise, that sediments occasionally become solidified by simple desication. The shell-marl, or calcareous tufa, of our swamps, &c., becomes thus hardened on exposure to the air.

(3) *Changes to which the Sedimentary Rocks, collectively, have been subjected.*—These changes comprise, principally : (*a*) Elevation above the sea level, with alternations of upheaval and depression; (*b*) Denudation; (*c*) Tilting up and Fracturing; and (*e*) Metamorphism and Cleavage. It is, of course, to be understood that whilst certain strata may have experienced all of these effects, others, on the contrary, have been subjected to upheaval, or to upheaval accompanied by denudation, only.

(*a*) *Elevation above the Sea Level.*—The stratified rocks, it has been shown, must have been deposited originally in the form of sediments, under water; and from the marine remains which so many of them contain, it is evident that as a general rule they were laid down on the bed of the sea, either in deep or in shallow water. We find these rocks, however, now, at various heights above the sea-level, and frequently far inland. Hence of two things, one: either the sea must have gone down, or the land must have been elevated above the water.

The sinking of the sea would appear at first thought to be the more rational explanation of this phenomenon; but if we look to existing Nature, we find no instance of the going down of the sea, whilst we have many well-proved examples of the actual rising and sinking of the land. In connexion with this inquiry, it must be borne in mind

that the sea cannot go down or change its level at one place without doing the same generally all over the world.

To afford a few brief illustrations, it may be observed that on several occasions within the present century, large portions of the Pacific coast of South America have been raised bodily above the sea, leaving beds of oysters, mussels, &c., exposed above high-water mark. The phenomenon, to the inhabitants of the coast, appeared naturally to be due rather to a sinking of the waters than to an actual elevation of the land; but at a certain distance north and south of the raised districts, the relative levels of land and sea remain unaltered: and hence, if the sea had gone down within the intervening space, its surface must have presented an outline of this character , a manifest impossibility.

The land is also known to be slowly rising and sinking in countries far removed from centres of volcanic activity. Careful observations have shown, for example, that the northern parts of Sweden and Finland are slowly rising, and the south and south-eastern shores of the Scandinavian peninsula are slowly sinking: whilst around Stockholm there is no apparent change in the levels of land and sea. The whole of the western coast of Greenland is slowly sinking; buildings erected on the shore by early missionaries, being now in places under water. A slow movement of depression, it is likewise inferred, is taking place along a considerable extent of the Atlantic sea-board of the United States. (See *Canadian Journal*, vol. ii. new series, p. 480.) On the shores of Newfoundland, of Cornwall, and other districts, examples occur of sub-marine forests, or of the remains of modern trees, in their normal position of growth, below low water-mark; whilst in neighbouring localities no change of level appears to have taken place. Besides which, without extending these inquiries further, we know that many fofsiliferous strata are hundreds, and even thousands, of feet above the present sea-level:—on the top of the Collingwood escarpment, for example, we find strata containing marine fossils at an elevation of over 1500 feet above the sea; and on the Montreal mountain, shells of existing species occur at an elevation of about 500 feet. And hence, if these strata had been left dry land by the sinking of the oceanic waters in which they were deposited, an immense body of water, extending over the whole globe, must in some unaccountable manner have been caused wholly to disappear. It is therefore now universally admitted, that the sedimentary rocks

have come into their present positions, not by the sinking and retiring of the sea, but by the actual elevation of the land.

Many strata afford proofs of having been elevated and depressed above and beneath the sea, successively, at different intervals. Many sandstones, for example, exhibit ripple-marked surfaces, and some, impressions of reptilian and other tracks, through their entire thickness. This indicates plainly that they were formed slowly in shallow water, and that they were left dry, or nearly so, between the tides. And it indicates, further, that the shore on which they were deposited layer by layer, was undergoing a slow and continual movement of depression, otherwise the process of formation would necessarily have ceased, and the strata would present a thickness only of a few inches, or of a few feet at most. Afterwards a period of upheaval must have commenced, bringing up the rocks to their present level. In certain strata, also, the upright stems of fossil trees occur at various levels; and in some localities, beds containing marine fossils are overlaid by others holding lacustrine or fresh-water forms; and these again by others with marine remains. Finally, to bring this section to a close, we have a striking example of alternations of land-upheaval and depression in the geology of Canada generally. Around Toronto, for example, we have strata of very ancient formation, belonging to the Lower Silurian series, overlaid by deposits of clay, gravel, and sand. Between the two, a vast break in the geological scale occurs. In other parts of this continent, many intervening formations are present (see the Table of Rock Groups, a few pages further on); and hence, it is concluded, that the Silurian deposits of this locality, after their elevation above the sea, remained dry land for many ages, whilst the intervening groups were under process of deposition in other spots; and that, finally, at the commencement of the Drift period, the country was again depressed beneath the ocean, and covered with the clays, sands, and boulders of this latter time. Another period of elevation must then have succeeded, bringing up both the Silurian and the Drift formations to their present levels above the sea.

(*b*) *Denudation.*—This term, in its geological employment, signifies the removal or partial removal of rock masses by the agency of water. The abrading action of the sea, of rivers, &c., acting under ordinary conditions, has already been alluded to; but the erosive effects of water, under conditions now no longer existing, may be seen in numerous localities. Sections of the kind shewn in the accompanying

figure, for instance, are met with almost everywhere, producing undulating or rolling countries. Here it is evident that the strata were once continuous in the space between *a* and *b*.

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Valleys thus resulting from the removal of strata, are termed "valleys of denudation." Some of these valleys are many miles in breadth. Their excavation, consequently, could not have been caused by the streams which may now occupy their lower levels. Their formation is universally attributed to the denuding action of the sea during the gradual uprise of the land in former geological epochs. Frequently isolated patches of strata are left by denudation, or are cut off by wide distances from the rocks of which they originally formed part. These are termed "outliers." Thus in Western Canada, small isolated areas, occupied by bituminous shales of the Devonian series, occur in the townships of Enniskillen, Mosa, &c., and constitute outliers or outlying portions of the Chemung and Portage group (see Part V.), as largely developed in the adjoining peninsula of Michigan. The matter carried off in some districts by denudation, must have been of enormous amount; and when it is considered that most of the inequalities on the Earth's surface—those at least not immediately connected with mountain chains—have arisen from this action, it will readily be perceived that materials for the formation of newer strata were abundantly provided by this means alone.

(*c*) *Tilting up and Fracturing of Strata.*—Whilst some strata retain their original horizontality, others are more or less inclined, and some few occupy a vertical and even a recurved position. That strata were not originally inclined, at least to any extent, is proved by the known arrangement of sediments when diffused through water,—these (with the exceptional cases already pointed out) always depositing themselves in horizontal, or nearly horizontal, layers. The same fact

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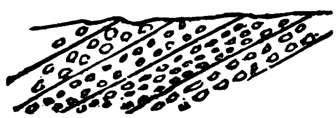
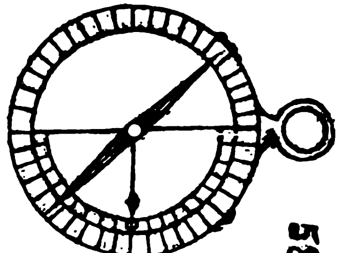


57.

is shewn also by the frequent presence of rows of pebbles, fossil shells, &c., parallel with the planes of stratification, as in fig. 56; by the occasional presence of the fossilized stems of trees (evidently in their positions of growth) standing at right angles to these planes (fig. 57); and sometimes by the presence of stalactites suspended in a similar position.

The inclination of strata is technically termed the *dip*; and the direction of the up-turned edges, the *strike*. The dip and strike are always at right angles. In observing the dip, we have to notice both its angle or amount, and its direction,—as north, north-east, N 10° E, and so forth. The direction of the dip is of course ascertained by the compass; the rate of inclination, by the eye, or by an instrument called a clinometer. The most convenient instrument for both purposes, is a pocket compass, furnished, in addition to the needle and graduated limb, with a moveable index hanging from the centre of the compass and playing round a graduated arc, as in the annexed outline (fig. 58.) When the line *A—B* is held horizontally, the index *I* hanging perpendicularly, cuts the zero mark of the graduated arc. From each side of this point, the graduation is carried up to 90°. If, consequently, the line *A—B* be placed parallel with the dipping beds of any strata, the angle of the dip will be at once shewn by the index. A contrivance of this kind, exclusive of the compass, may be easily made out of a semicircle of hard wood. The index may consist of a piece of twine extending below the graduated limb, and kept taut by a lead plumb or by a stone.



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When strata dip in two directions, the line along the culminating point of the strata is termed an *anticlinal* or *anticlinal axis* (= *a* in fig. 59); and the line from which the strata rise (= *s* in fig. 59), is called a *synclinal* or *synclinal axis*. Synclinals when of a certain magnitude, constitute "valleys of undulation." Anticlinals are also often hollowed out by denudation, forming valleys or troughs called "valleys of elevation" (= *e* in fig. 59.) The term "elevation" applies here, however, to the raised strata, and not to the actual position of the valley, as many of these so-called valleys of elevation lie in the

beds of rivers, or occupy comparatively low ground. The city of Cincinnati is situated in a remarkable valley of this kind. Finally, it must be observed, that when strata lie in parallel beds (as in fig. 59),

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the stratification is said to be *conformable* or *concordant*. When on the other hand, the beds are not parallel, the stratification is said to be *unconformable*. The accompanying section, in which the inclined beds belong to the Laurentian, and the overlying beds to the Lower Silurian series (see PART V.), as shown on Crow Lake, north of Marmora village) is an example of unconformable stratification, or of want of concordance between these two series of rocks. As explained further on, a want of conformability always indicates a geological break, or the commencement of a new geological period.

Both horizontal and inclined strata frequently exhibit fractures of greater or less extent. Mineral veins, it may be mentioned, consist essentially of cracks or fractures running through the surrounding rocks, and filled up, by various agencies, with sparry, earthy, and metallic matters. The strata on one side of a fracture are often displaced, being thrown up or down, as it were. This peculiarity is technically termed a *fault*. An example is shewn in the annexed diagram. The levels occupied by a displaced bed are sometimes only a few inches, and at other times upwards of a thousand feet, apart. At the first formation of a fault or slip, an escarpment or terrace of greater or less height must necessarily have arisen ; but in very few cases (if in any case unconnected with existing earthquake phenomena) is anything of this kind now observable, the ground having

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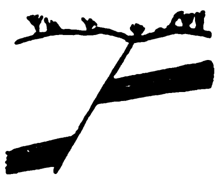

been levelled down by the agency of denudation. In mountainous districts, the fracturing of strata has sometimes given rise to narrow valleys or gorges, called "valleys of dislocation," most of which have been subsequently widened by the atmospheric disintegration of the surrounding rocks, and by the streams or torrents of which they usually form the channels.

(e) Metamorphism and Cleavage.—The subject of metamorphism has already been sufficiently explained, under the head of Metamorphic Rocks, above. It is merely alluded to here as one of the changes to which strata of various geological ages have been subjected. The term "cleavage" is applied to a peculiarity affecting many clay-slates, and occasionally other strata. The rocks thus affected, are rendered eminently fissile or slaty by numerous cleavage planes which run through them in a direction generally inclined to that of the lines of bedding. The latter, in inclined strata especially, are sometimes distinguished with difficulty from the planes of cleavage, but they may be discovered by tracing out lines of fossils, or intercalated bands of a slightly different mineral composition, colour, &c., which mark, of course, the planes of deposition, and across which the cleavage lines usually pass without interruption. That cleavage is a superinduced effect, is shewn by this latter circumstance, and more particularly by the fact that imbedded fossils and stones are frequently elongated in the direction of the cleavage planes. The cause of the phenomenon is still exceedingly obscure; but it is now very generally regarded as due to long continued pressure acting at right angles, to the lines of cleavage, whilst the rock was permeated by water or steam, or whilst it still retained its sedimentary condition. Many of the slates of the Eastern Townships, as those of Richmond, Kingsey, Melbourne, Westbury, &c., owe their fissility to superinduced cleavage.

CLASSIFICATION OF ROCKS IN ACCORDANCE WITH THEIR RELATIVE AGES.

Our preceding illustrations have shewn us the distribution of rocks into three great groups—Eruptive, Metamorphic, and Sedimentary rocks—in accordance with their modes of derivation or general formative processes. But these rocks admit of another and far more interesting classification: one based on their relative ages or periods of formation.

It is now universally admitted, on proofs the most unanswerable, that the various sedimentary and other rocks which make up the solid portion of our globe, were not formed during one brief or unbroken period, but were gradually elaborated and built up during a long series of ages. In areas of very limited extent, for example, even in the same cliff-face, or in excavations of moderate depth, we often find alternations of sandstones, limestones, clays, &c., lying one above another, and thus revealing the fact that the physical conditions prevailing around the spot in question must have been subjected to repeated changes. The same thing is also proved by alternations of marine and fresh-water strata in particular localities; and of deep-sea and shallow-sea deposits, in others. Again, the sedimentary rocks are frequently found in unconformable stratification, as explained above: horizontal beds resting upon the sloping surface or upturned edges of inclined strata. (See fig. 60.) Here it is evident that the inclined beds must have been consolidated and thrown into their inclined positions before the deposition of the horizontal beds which rest upon them. In the absence of particular sets of strata in special localities, proving extensive denudation or long-continued periods of upheaval and depression—in the vast metamorphic changes effected throughout many districts—in the upward limitation of faults (fig. 62), as sometimes seen—and, briefly, in the worn and denuded surface which a lower formation often presents in connexion with strata resting conformably upon it,—we have additional evidence of the lapse of long intervals of time during the elaboration of these rocks generally.

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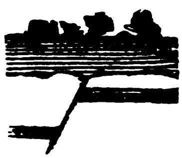

But a still more conclusive proof of this fact is to be found in the limited vertical distribution of fossil species of plants and animals, the remains of which are entombed in so many of the sedimentary rocks. The sediments now under process of deposition in our lakes, river-estuaries, and seas, frequently enclose, it will be remembered, the more durable parts, if not the entire forms, of various plants and animals belonging to existing creations. In like manner, the sedimentary deposits of former geological periods have enclosed also various organic forms peculiar to those periods. Each group of strata has thus its own characteristic fossils, except that in the lowest or earliest-formed series of deposits we meet with no traces of ancient life. These deposits belong to the *Azoic Age* of geological

history. All the succeeding periods have left us, in the rocks then under process of formation, vestiges, at least, of their organic types—those of each period differing more or less entirely from the forms which occur in both underlying and overlying strata. These facts are brought out more fully in the succeeding part of this Essay, in which the leading questions connected with the subject of Organic Remains, come under review. For present purposes, it will be sufficient to observe that by the careful study and comparison of these remains, geologists have subdivided the rock-groups into a certain number of formations, indicating the bygone ages and periods of the Earth's history. Without entering at present into minute or controverted subdivisions, we may group these various formations as in the annexed tabular view :

Modern Formations.	
Drift Deposits.	
CAINOZOIC OR TERTIARY ROCKS.	
MESOZOIC or SECONDARY ROCKS.	Cretaceous Series.
	Jurassic Series.
	Triassic Series.
PALÆOZOIC ROCKS.	Permian Series.
	Carboniferous Series.
	Devonian Series. (For Canadian Sub-divisons, see PART V.)
	Silurian Series. (For Canadian Sub-divisions, see PART V.)
AZOIC ROCKS.	Huronian Series.
	Laurentian Series.

Notes on the above Table.

(1) The formations enumerated in this table, are never found altogether: that is to say, they never exhibit a complete series at any one locality. But they are known to occur in this order, by a comparison of their relative positions at different places. Thus, in one district, we find (in ascending order) the Silurian and Devonian series; in another, the Devonian and Carboniferous, and so on.

(2) In Canada proper, the following series alone occur:

Modern formations.
Drift deposits.
Carboniferous series (in part only, in Gaspé.)
Devonian series.
Silurian series.
Huronian series.
Laurentian series.

These comprise, lithologically, various sedimentary and metamorphic strata, with, in some cases, accompanying eruptive rocks, as described fully in PART V.

(3) One or more of several consecutive formations (as shewn in Note 2) are often "wanting" or absent at a given spot. The Carbonifeorus rocks may thus, in certain districts, be found resting on the Silurian, without the intervention of the Devonian series. But the relative positions of these groups are never reversed. The Devonian beds are never found under the Silurian, for example, nor the Cretaceous under the Jurassic. The absence of particular strata, at a given locality, is accounted for by the elevation of the spot above the sea-level during the period to which the strata in question belong; by denudation, or by the district having been situated beyond the area of deposition to which the sediments extended. (See some of the preceding observations under "Formation of Sedimentary Rocks," "Denudation," &c.)

(4) A formation of a given age may be represented in one place by a limestone; in another, by a sandstone; in a third, by argillaceous shales, and so on. This will be easily understood, if we reflect that at the present day these different kinds of rock are being formed simultaneously at different places. Many of our preceding observations have amply illustrated this, but the fact may be rendered still clearer by the accompanying diagram. In this sketch, the dark outline is intended to represent a somewhat extended line of coast, with a river debouching into a deep bay. In the latter, the argillaceous or muddy sediments (*m*), brought down by the river, may be deposited. At G, we may suppose a granitic headland. The arenaceous or siliceous sediments (*s*) derived from the disintegration of this, will be arranged along the shore beyond it, by the set of the current. Finally, at L, we may suppose the occurrence of exposed cliffs of

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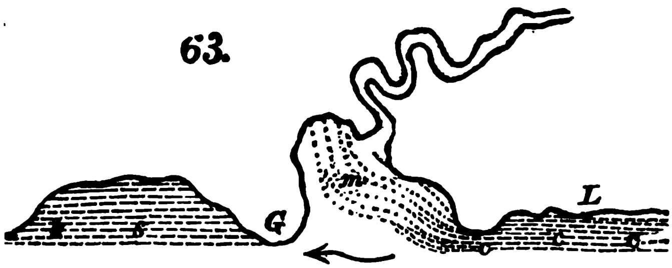

limestone, yielding calcareous sediments (*c*). These various sedimentary matters will be also in places more or less intermingled, producing rocks of intermediate or mixed composition. But these rocks will be shewn to be of the same period of formation, by the identity of some, at least, of the organic bodies enclosed in them. As recent formations, moreover (although many of the enclosed shells, &c., would necessarily be distinct, owing to the diverse nature of the sediments, the more or less exposed character of the coast, the varying depths of water prevailing at different parts, &c.,) we might expect to find in one and all, coins, pieces of pottery, and other objects of human workmanship, proving their contemporaneous origin. Hence, the age of a rock is in no way indicated by mineral composition: sandstones, limestones, &c., are of all geological periods.

(5) From time to time, during the gradual deposition of these sedimentary formations, various eruptive rocks were driven up amongst them, producing (in general) chemical or mechanical alterations of greater or less extent. This action is still going on, as witnessed in volcanic phenomena.

(To be continued.)

ADDITIONAL NOTE ON THE CRYSTALS OF LAZULITE DESCRIBED IN THE JULY NUMBER OF THIS JOURNAL, PAGE 363.

Since the publication of my remarks on the American variety of Klaprothine or Lazulite in the last number of the Journal, I have received a communication from Professor George J. Brush, of Yale College, New Haven, informing me that the crystals in question do not come from North Carolina, but from Georgia. They occur at

Graves' Mountain in Lincoln County of that State. The North Carolina examples analysed by Smith and Brush have not been met with in crystals.

Professor Brush also informs me that these Georgian crystals have been described and figured in a paper by Professor Shepherd (by whom they were discovered) in the *American Journal of Science and Arts*, Vol. XXVII. (2nd series), page 36. This paper has quite escaped my notice, and I have at present no means of referring to it. I hasten, however, in apologising for past negligence, to point out the fact of its publication. As regards the assumed trimetric character of these crystals, my views, I may venture to observe, remain unchanged.—E. J. CHAPMAN.

Orillia, C. W., August 15, 1861.

SELECTED ARTICLES AND TRANSLATIONS.

ON THE OCCURRENCE OF FERMENTATION-PRODUCING INFUSORIA, CAPABLE OF LIVING WITHOUT FREE OXYGEN.

BY M. L. PASTEUR.

(Translated from the Comptes Rendus, of February 25, 1861.)

[As this communication has attracted much attention in France, we venture to lay a translation of it before the readers of the *Canadian Journal*. We should remark, however, that the animal nature of the infusoria discovered by M. Pasteur, does not appear to be absolutely proved.]

The formation of a great variety of products in lactic fermentation is a well known fact. Lactic acid, a peculiar gum, mannite, butyric acid, alcohol, carbonic acid, and hydrogen, make their appearance either simultaneously or successively, and in extremely variable and uncertain proportions. I have been led gradually to the conclusion, that, the vegetable ferment which transforms sugar into lactic acid differs from the ferments,—for two exist—which give rise to the gummy matter; and that these latter again, do not ever engender lactic acid. I have found, also, that these different vegetable ferments, *if perfectly pure*, cannot under any conditions originate butyric acid.

A special butyric ferment must therefore exist. On this point I have fixed for some time my undivided attention; and the present communication is devoted to this question, that is to say, to the origin of butyric acid in the so-called lactic fermentation. Without entering here into all the details of my experiments, I may state at once the following result, namely: that the butyric ferment consists of a species of infusoria. So far was I from expecting this result, that for some time I did my best to prevent the development of the infusoria, fearing that these minute creatures lived upon the supposed vegetable ferment which I thought gave rise to the butyric fermentation, and which I sought to discover in the liquid media employed in my researches. But failing to make out the origin of the butyric acid, I finished by being struck with the remarkable coincidence between the presence of this acid and the infusoria, the one always accompanying the other; and since then, an extended series of experiments has convinced me that to these infusoria is exclusively due the transformation of sugar, mannite, and lactic acid, into butyric acid. We must therefore, consider these minute animals as the true butyric ferment.

With regard to their description, it may be stated that they form small and usually straight cylindrical lines, rounded at the extremities, and either free, or united in chains of two, three, four, or even a larger number of individuals. The isolated forms are about 0·002 of a millimeter in breadth, and are from 0·002 to 0 05 or 0·02 in length. They move with a gliding (or jerking) motion, the body either remaining rigid, or exhibiting slight undulations. At times also, they turn upon themselves, and cause the extremities of their body to vibrate rapidly. The undulatory movements of the body become very evident when the length reaches 0·015 of a millimeter. One extremity is frequently curved, and occasionally both ends of the body exhibit a curvature, but curved forms are rare at the commencement of life.

The reproduction is fissiparous; and to this mode of generation the chain-like groupings are evidently due. In these chains, the last individual may frequently be observed in comparatively violent motion in its attempts to detach itself from the rest.

Although, as I have said, the body of these *Vibrionidæ* is cylindrical in form, it often appears to be made up of a faintly-marked series of very short articulations. These undoubtedly represent the first stage in the development of the infusoria.

The propagation of these forms may be effected as in the case of yeast. They multiply readily if the medium be appropriate to their nourishment. It is a remarkable fact, indeed, that they may be propagated in a liquid containing merely sugar, ammonia, and phosphates: crystallizable and, in a manner, mineral substances. Their reproduction goes on with the appearance of butyric fermentation, the presence of which is always clearly manifest; and although the weight of the ferment thus produced (as in other ferments) is always small as compared with the total weight of the butyric acid, it is still sufficiently marked.

The existence of infusoria possessing the character of a ferment is a circumstance in itself well worthy of attention; but in this instance it is rendered the more striking by the fact that these infusoria live and multiply without requiring the smallest quantity of atmospheric air or free oxygen. It would occupy too much space to explain here, the means by which I have guarded against the entrance of free oxygen into the solutions and vessels in which these creatures swarm and multiply by myriads, but the complete exclusion of this element has been thoroughly proved. I will merely add in confirmation, that before presenting my results to the *Académie*, I have obtained the testimony of several of its members, before whom I have exhibited my experiments, as to the correctness of this assertion.

Not only do these infusoria live without air, but its presence actually destroys them. So long as a current of pure carbonic acid is transmitted through the liquid in which they live and multiply, their development is in no way affected; but if, under exactly similiar conditions, the carbonic acid be replaced by a current of atmospheric air for the space of two or three hours only, all perish; and the butyric fermentation, connected with their presence, ceases at the same time.

We arrive therefore at these two conclusions:

1. *The butyric ferment is an infusorial animal.*

2. *This infusorial species lives without free oxygen.*

The present example is, I believe, the first recorded case of an animal ferment, and also of an animal capable of existing without the presence of oxygen in the free state.—E. J. C.

ON THE OCCURRENCE OF AMERICAN BIRDS IN EUROPE.

BY H. GÄTKE, OF HELIGOLAND.

(*From the Proceedings of the Zoological Society of London.* 1860.)

The route by which American birds proceed to Europe is, as Yarrell justly terms it, "an interesting problem, of difficult solution." For years this solution has occupied my attention, and although I have myself always been convinced that such of these entirely American birds as occasionally visit Europe *do* reach us by a passage across the Atlantic, this remains a mere opinion, carrying no weight if unsupported by facts, or by at least sufficient argument to make good the question at issue.

The mere comparative review of the occasional visitors among the birds of Great Britain and of Germany will lead to the conclusion that the route of American birds to Europe must needs be a voyage across the Atlantic, for almost all the additions to the birds of Europe, of species *purely American*, have been obtained in Great Britain—which could not have been the case if they had proceeded in any other than an eastern direction—whilst the additions by Germany, furnished to the European Ornis, consist nearly entirely of birds belonging to Asia.

However striking the result of such a comparative review may be, one question will always present itself, namely:—Whether it be possible for a bird to sustain an *uninterrupted* flight sufficient to carry it across the wide expanse of the Atlantic. I am convinced that this is possible, and shall endeavour to prove such possibility.

This purpose necessitates a measure for the rate of locomotion of a bird through the atmosphere. For a long time I vainly endeavoured to obtain reliable data upon which to found an estimation of the rate of flight of birds—when at last I hit upon a passage in Yarrell's "British Birds," ii. p. 295, where, speaking of the Carrier Pigeon, he mentions the fact of one of these birds having performed a flight of 150 miles in an hour and a half: it was on the 24th of June, 1833; the Pigeon flew from Rouen to Ghent; sixteen others flew the same distance in two hours and a half.

Wonderful as this instance of swiftness of the flight of a bird may appear, it certainly is still surpassed by birds when on their periodical

migrations; for the above feat was accomplished by an individual hatched and reared in at least semi-confinement, whose powers of flight consequently could not be nearly so well developed as in a bird grown up wild and free, which nearly every hour of his life has to depend on the utility of its wings, either for the purpose of overtaking its prey, or for that of escaping from being caught.

Laying down, therefore, 100 geographical miles per hour as the rate of flight of birds during distant migration, one keeps—after the above—quite within safe bounds, and, at this rate, the 1600 geographical miles from Newfoundland to Ireland would be effected in sixteen hours. No ornithologist will doubt for a moment the capability of a healthy bird to sustain a flight of that duration; during the long summer days many of the *Hirundinidæ* are on the wing for as long a period, and although their flight may be interrupted by occasional rests of very short duration, it is performed in the lower, less buoyant atmosphere, and consists of so many evolutions, that most decidedly it must on the whole be much more tiresome than the straight path, in the pure upper regions, of a bird bent on the performance of one long pilgrimage.

Even supposing that birds become exhausted before accomplishing the passage across the ocean, observations I have made in the vicinity of this island have fully convinced me that small birds, such as Thrushes, Buntings, Finches, &c., are able to rest on the sea—even when a little in motion—and afterwards to resume and pursue their flight with fresh vigour. Of this I shall give the particulars further on; but, for the present, return to the above question, by giving an instance of endurance on the wing of a species which, with pretty good certainty, may be said every spring to perform in the period of one night, a flight of more than 1200 geographical miles; namely, from Egypt to Heligoland—the bird in question being a particular form of Blue-throated Warbler, *Sylvia cœrulecula*, Pallas.

This pretty little bird, noted not at all either for rapidity or great endurance of flight, has its summer quarters in the high northern latitudes of Sweden, Finland, and Siberia, whereas during the winter months it is staying principally in Egypt. On its spring migration, which takes place during the earlier half of May, the first place north of Egypt where it is to be found with certainty in pretty considerable numbers is Heligoland. Nowhere in the whole intermediate distance is it met with but as a great rarity—not even on the neigh-

bouring north coast of Germany—while here in Heligoland I have oftentimes obtained it in such numbers that more than twenty of the finest adult male birds have been bought by me in one day, and perhaps the same number by the bird-stuffers of the island. The foregoing admits of one conclusion only, namely, that this little bird performs the passage from Egypt to Heligoland in one uninterrupted flight, travelling—as many of the other small *Insectivoræ* do—during the night, starting towards sunset and arriving here about sunrise, or a little later, the time occupied being from twelve to fourteen hours. The distance from Egypt to Heligoland being about 400 geographical miles less than that between Newfoundland and Ireland, the rate of flight of this delicate little bird may be put down the same as that rendered by the above-mentioned Carrier Pigeon, and consequently furnishes a further proof that a healthy, well-flying bird is able to cross from the nearest point of America to Ireland without rest or any extraordinary support whatever.

In the foregoing I alluded to the aptness of non-natatorial birds of resting, in case of exhaustion, on the sea, and of rising from it after having recovered sufficient strength to resume their flight; and that at times, too, when the water is far from being unruffled. This statement is based on the following observations. One day, when out in a boat shooting, about two or three miles from Heligoland, I observed a very small bird swimming on the water. Neither the boatman nor myself being able to discern what species it belonged to, we became very eager to secure the stranger—conjecturing that it would turn out to be some wonderful rarity. When preparing to fire, I fortunately discovered that the expected prize was nothing but a Song-thrush! Immediately our desire to kill was changed into compassion: the "*poor Thrush*" in so piteous a situation was to be "*saved.*" But how great was our astonishment, when, upon the approach of the boat, the bird without any apparent difficulty rose from the water and flew towards Heligoland in first rate style! Another time we saw a Snow-bunting, evidently exhausted very much, because it was floating scarcely 500 yards from the island. At the approach of my boat, this bird also very lightly rose from the water, but it was so weak that it had to resume its unnatural resting-place after proceeding about thirty or forty yards towards the rocks. We went after it again, and for a third time, but with the same result, whereupon we refrained from all further attempts at forcing our well-intended assistance upon

so obstinate a fellow—the more so as we entertained no doubts that after a little rest he would obtain a more solid footing without any help of ours.

I will give one more instance of this propensity in birds—in all my experience the most striking: this time it was a Mountain-Finch which had been compelled to alight for rest on the water of the sea; it was about three miles west of Heligoland. When this bird was approached by the boat, it rose very easily, mounted into the air to a great height—as birds do when starting for their migratorial excursions—and then struck out steadily in a southern direction, *without taking any notice whatever of the island.*

Although I believe in the foregoing to have proved sufficiently the *possibility* of birds being capable to cross on the wing from the United States of America to Great Britain, the greatest *probability* that they do so is still shown by the proportion the number of American birds obtained in Great Britain bears to that of those obtained in the whole of Europe. Yarrell, in his "British Birds," 1845, mentions more than forty instances of that description; *Tringa rufescens* and *Scolopax grisea* having been obtained six times each! whereas Germany, Holland, and France together, offer but very few instances—some of which scarcely rest on good authority.

Heligoland seems to form a happy centre. Here the gulls of the Arctic Sea, *Larus rossii* and *sabinii*, meet the Numidian Crane, *Grus virgo*, *Lanius phœnicurus*, and other African birds; whilst the United States send *Mimus rufus* and *T. lividus*, *Sylvicola virens*, *Charadrius virginicus*, and others, to meet deputations from the far east of Asia, consisting of *Turdus rufficollis* and *T. varius*, *Sylvia javanica*, *S. caligata*, and *S. certhiola*, *Emberiza rustica*, *E. pusilla*, and *E. aureola*, *Pyrrhula rosea*, and a great many others.

All these birds, together with a great number of acquisitions quite as valuable for the European Ornis, *all captured on this island*, are preserved in my collection—a collection which, although scarcely approaching to three hundred specimens, has, by Blasius, been pronounced to be "the most interesting between Paris and Petersburg."

AGRICULTURAL MANUFACTURES.

BY S. COPLAND.

(From the Journal of Agriculture, July, 1861.)

The discovery of sugar in the plants of Europe is of modern origin, dating not farther back than the middle of the last century. It was in 1747 that M. Margraaf, a Prussian Chemist, made this discovery in analysing the Silesian beet-root, and the fact was communicated by him to the scientific world, as one of the curiosities of nature, but not as likely to lead to any beneficial practical result. It made some noise at the time amongst men of science, and without any immediate important action. Like the discovery of steam power, the electric telegraph, and many other useful inventions, it was kept in abeyance for half a century, and only brought out into public notice and utility through a political necessity.

About the close of the last century, France had been denuded of most of her sugar colonies. Domingo, the principal one, had become free by the insurrection of the slaves, who had cleared the island of their former masters, and would no longer make sugar. This alone deprived France of a supply of upwards of 150,000,000 pounds per annum of that condiment; other of the colonies had been wrested from her by the British, and so low was the supply of sugar reduced, that the French chemists were directed by the Government to investigate the subject of indigenous sugar, and see whether the discovery of Margraaf could not be turned to national advantage. One of the chemists thus employed, M. Achard, also a Prussian, stimulated by the high price of sugar on the Continent, and by the proposed rewards of the French Government, directed his attention solely to this subject. He published a treatise on the cultivation of the Silesian beetroot, and the mode of manufacturing sugar therefrom. Such, however, was the imperfection of the processes then used, that not only was the product so small as to amount to only $3\frac{3}{4}$ per cent, but the quality of the sugar was such that nothing but the necessity of the case would have tolerated its use.

From this period the attention of the people of continental Europe was directed to the subject. In France, the Government ordered that 100,000 hectares should be devoted to the cultivation of the sugar or Silesian beetroot, and the highest encouragement was held out to those who should most promote the native industry.

The interruption of the trade with those colonies which still remained to France, and which they soon after lost by the conquest of the British, induced the French directory, and afterwards the Imperial Government, to push forward the manufacture as much as possible. The price of sugar, indeed, on the Continent, was of itself a sufficient inducement. The issuing of the Berlin and Milan Decrees by Napoleon, by which all intercourse with England was as strictly interdicted as so extended a seaboard would admit of, raised the price of raw sugar to five francs (4s. 2d.) per kilogramme, or about 2s. per pound. On the other hand, by the aid of science, not only was the quality greatly improved by the employment of chemical agents in its purification, but the product was increased from $3\frac{3}{4}$ to 4, 5, 6, and eventually 7 per cent.

The existence of saccharine matter is not confined, amongst our domestic and other plants, to the beetroot. It is found in them all to a greater or less proportion, but greatest in that of the Silesian beet and its varieties. All the mangold-wurzel tribes possess it, but only the Silesian and its varieties in sufficient quantity to render its manufacture profitable. The Chinese sugar-cane, or sorgho, has, however, been recently introduced, and is now extensively cultivated in the south of France for the same purpose, and is found to yield a full proportion of sugar, below a certain latitude. It is a remarkable provision of nature, that, taking the latitude of 45° as the line of demarcation, the quantity of saccharine in bulbous plants rises as you advance towards the north, and decreases towards the south; and that, on the other hand, the gramineous plants, such as the cane, maize, sorgho, &c., increase their saccharine properties as they advance towards the south, and lose it towards the north. In the neighbourhood of Marseilles, for instance, the sorgho is found to yield fully 7 or 8 per cent. of sugar, whilst in the neighbourhood and latitude of Paris it does not contain more than 4 or 5 per cent. On the other hand, no beet sugar factories are to be found on the Continent below 45°.

It is proper to state here, that there are in commerce two descriptions of sugar, possessing different characteristics, and requiring different processes in their production. The first and best of these is extracted in its perfect state, by mechanical means alone, from the cane and its varieties, the beetroot, and the maple. This sugar crystallises after condensation by boiling, and is identically the same in these three substances in properties and composition when similarly manufactured. That from beetroot, however, is said by

chemists to be the strongest in saccharine power, and forms the finest crystals.

The second kind is what is termed a *factitious sugar*, the product of the grape and other ripe fruits, and starch or farina. This kind is something similar to the common East India sugar, soft and weak, not forming regular crystals, as at present manipulated, but settled into tufted concretions, like the head of a cauliflower. The product of these is greater than that of the former, the grape containing about forty per cent. of saccharine matter; whilst the farina, being itself already a residuum reduced by a simple mechanical process, requires only the addition of a chemical agent—sulphuric acid—to convert the whole mass into sugar, weight for weight. In fact, by the addition of the chemical agent, and the water necessary to dilute it, 1 cwt. of farina willl produce 1¼ cwt. of sugar. Both these factitious sugars, upon being tested by the saccharometer, prove to be greatly inferior to the first description, containing a proportion of not more than 60 to 100 of saccharine power. It is, therefore, only when the potato is cheap enough to be manufactured into farina that it will be profitable to make sugar from it. The sulphuric acid is used in the proportion of 1 part to 100 of water. The process is too long to be inserted here; but it may be stated that diseased potatoes will yield starch as well as those that are sound. In the fatal years of 1846, 7, and 8, an immense quantity of diseased potatoes, in all stages of decay, were brought from the country into Dublin, and purchased by a starch maker, who made a fortune by extracting the farina. The process is so simple and inexpensive that we are surprised it has not been adopted by the English and Scotch potato-growers, in those seasons when the disease is general.

Whilst the Napoleonic wars continued, and foreign produce was excluded, the price of sugar was sustained, and the manufacturers having a monopoly, made but little progress in improving the quality of their article. It was neither properly clarified nor perfectly crystallized, and nothing but the absence of competition with colonial sugar enabled the manufacturers to sell the wretched stuff they made; and when the peace of 1815 returned, and it had to sustain the competition, the manufacture rapidly declined, notwithstanding a high protecting duty, and the desire of the Government to support it as a permanent branch of national industry. In 1828 the quantity produced was only 4800 tons, being the lowest ebb to which it was reduced.

Since that period, not only has the manufacture recovered itself, but it has been firmly established amongst the industrial pursuits of the country, as one of its most profitable branches of commerce and of rural economy. In 1829, Count Chaptal, who was the most extensive grower of beetroot and manufacturer of sugar, being at the same time an eminent chemist and agriculturist, published his process in a work entitled *Chimie appliquée à l'Agriculture*. From that period the manufacture has steadily advanced; and such have been the improvements effected in the processes, that the quality of the produce now equals that from the West Indies, except that a slight taste of the beetroot still remains. This, however, does not apply to the refined or loaf sugar, which is perfectly free from any taste of the root. There are now in France, according to Lavergne, about 350 sugar works, of which 150 are situated in the department of the Nord, to supply which 20,000 hectares (49,350 acres) of land are under beetroot; producing an average of about 36 tons per hectare (or 15 tons per acre), which, if we reckon 14 tons of roots to each ton of sugar, yields about 51,430 tons of that article.

With respect to the profitableness of the manufacture, the best proof of it is the vast extension it has taken, not only in France but throughout the Continent. For some years it was protected in the former country by a high duty upon colonial sugar; but since the year 1852, the duties on indigenous and on French colonial sugars have been equalized, and the manufacture has been found quite capable of standing the competition. The following statement is the actual result of an experiment, made at Tournay, in Flanders, of a patent process, upon 120,000lb., or 53 tons 11cwt. 2qrs. 40lb. of beetroot, the net produce of sugar from which was 8400lb., or 7 per cent. of uniform quality:

53 tons 1qr. 40lb. beetroot, at 15s. per ton				£40	3	6
Labour, coals, &c				39	7	6
Rent, interest, insurance, &c				10	0	0
Cartage, brokerage, &c				7	10	0
				£97	1	0
Deduct 45cwt. molasses, 8s	£18	0	0			
" 29 " pulp for cattle, 6s	7	6	0			
" 9 " skimmings, 1s	0	9	0			
				25	15	0
Cost of 3¾ tons sugar,				£71	6	0
or £18, 7s. 11d. per ton.						

This also agrees with a statement given by Sir K. Kane, in his *Industrial Resources of Ireland*, in which he makes the cost of sugar from beetroot to be £19 per ton, the difference arising from his charging the beetroot at 16s. 8d. instead of 15s. Thus, it is agreed on all hands that sugar can be made from beetroot at 2d. per lb., and with duty paid at 3d. per lb., which is considerably lower than it can be made for at the West Indies. It has also been discovered that, by a peculiar process, refined or loaf sugar can be made as well and as speedily from the syrups as from the raw sugar, which latter is the old practice. By this improvement, expense, time, and labour are greatly economised, and a much quicker return made of capital employed. It would be foreign to the object of this paper to go into the details of the manufacture; but I may observe that, so much has the process been accelerated, that the beetroot that is taken into the factory in the morning is converted into loaf sugar before night. The writer has seen a loaf of sugar that was made from the juice of the root in five or six hours; whilst, by the old process, it required a fortnight or more to drain the molasses from it in a perfect manner.

Whilst, however, this branch of industry has received a wide extension on the Continent, being introduced into all the German States, as well as France, Prussia, and Russia, we must notice a remarkable change that has occurred in its history; that is, that all the small factories have been abandoned, so that, although the quantity of sugar made has greatly increased, the number of sugar-works has decreased considerably. Since the protective duty was taken off colonial sugar, it has been found that the private establishments formed by the beet-growers themselves did not pay, and they have consequently been abandoned; whilst the larger ones, which are under the management of firms or companies, have flourished in a remarkable manner, and extended their operations up to the year 1858–9, when, from some cause which has never been fully explained, a falling-off in the produce of sugar took place. In 1857–8, the quantity of sugar made was 1,517,435cwt.; but in the following season of 1858-9 it amounted to only 1,303,796cwt. A still further reduction took place in 1859–60, when, up to the 1st January in the latter year, the quantity was 1,101,734cwt., against 1,124,016cwt. in the previous corresponding season. Thirteen small factories had suspended their operations, which accounts in a great measure for the falling off: whilst the injury done to the beetroots by the early frosts in the autumn of 1859 accounts for the unprofitableness of the manufacture with the smaller works. The present season, too, is not likely to

prove much more favourable than, if equal to, the last, in that respect—the entire summer having been unfavourable to the proper development of the saccharine in the roots, from the absence of sunshine. These however are temporary derangements of the manufacture, to which all branches of industry are liable, and which will doubtless be surmounted; and the question is, will the manufacture be profitable in the long-run in France and the other Continental states? because, if the affirmative can be established, there is no reason why it should not be equally so in this country.

By the price-current of the last few days, I find the value of Madras sugar is 39s. per cwt., duty paid (10s. per cwt.), which gives 28s. net, or 3d. per pound. From this must be deducted brokerage and other charges, amounting to (say) 2s. per cwt., leaving 2¾ths per pound, or 26s. per cwt. as the net return. This affords a large profit, assuming that the former estimate is anything like correct. The following will place it in the most unfavourable position that can be supposed:—

14 tons beetroot at 15s. per ton	£10	10	0
Cost of labour, coals, &c.	10	10	0
Rent, interest, insurance, &c.	3	0	0
Brokerage, cartage, &c.	1	15	0
	£25	15	0
13cwt. sugar, best crystalized, 26s.	£16	18	0
7 " do. middling, 21s	7	7	0
12 " molasses, 6s.	3	12	0
7½ " pulp, 6s.	2	5	0
	£30	2	0

This account shows that sugar can be made from beetroot to yield a handsome profit. The prices given are below the market value, and the beetroot is charged at its full value, in the country at least, in ordinary years, although this season the prices will probably range higher. The following passage from M. Lavergne on the subject is of considerable importance: "It was feared, in the first instance, that the cultivation of the sugar-beet would lessen the production of cattle and wheat by occupying the best lands. But this fear was ill-founded, at least relative to the best-cultivated regions. It is now demonstrated that the manufacture of sugar, by creating a new source of profit, contributes to increase the other products of the soil. The extraction of saccharine matter deprives the root only of a part of its elements. Its pulp and foliage supply the animals with an abun-

dance of food; and the returns of the sugar-works enable them to add commercial manures which indefinitely increase the fertility of the soil. In 1855, the city of Valenciennes, the principal seat of the manufacture, was able to inscribe upon a triumphal arch these significant words: "Produce of wheat in the arrondissement before the manufacture of sugar, 353,000 hectolitres, (120,146 quarters 5 bushels); number of oxen, 700. Produce of wheat since the manufacture of sugar, 421,000 hectolitres (144,782 quarters); number of cattle, 11,500."

The question, however, as M. Lavergne candidly admits, still remains to be decided, whether a still greater progress would not have been made if the manufacture had not existed, and the same capital and skill had been applied to agriculture and grazing; and he refers to the case of England as a proof of what may be done without allying manufactures to agriculture. There is, however, no doubt that in France the sugar manufacture has greatly stimulated the cultivation of land, and that far more manure has been made by the consumption of the pulp and the preserved foliage of the beet root than would have been raised had the manufacture never existed. On the other hand, the cultivation itself of 20,000 hectares (49,275 acres) of beetroot, producing to the grower, according to M. Lavergne, from £14 to £50 per acre, according to the quality of the soil, must have placed agriculture upon a very different footing from that which it occupied when there was no manufacture connected with it.*

The pulp or solid residue of the beetroot, divested of the juice, contains still from two to three per cent. of saccharine, and is greedily eaten by cattle and pigs, which fatten quickly upon it. Milch cows, although equally fond of it, will soon lose their milk, and go dry, if fed upon it, and their calves will die of inanition. This is probably owing to the small quantity of sugar and moisture it contains, which renders it unprofitable for the production of milk, which, as is well known, contains a large proportion of sugar.† The proportion of starch also, the basis of sugar, is only one per cent. on the residue, so

* The quantity of pulp is about 20 per cent. of the entire root; thus 1000 tons of the latter will yield 200 tons of pulp.

† In Tartary the natives convert milk into a species of sugar by the action of frost in the following manner: The milk, when new, is exposed in winter in broad shallow pans to the blast of the east wind. In a short time the aqueous parts of the surface are evaporated, and a white crispy crust forms, which is perfectly dry. This is scraped off, and the action of the frost is repeated; and so on from time to time, till the whole of the milk is thus converted into a dry powder, which, if kept from the air, may be preserved any length of time. It possesses all the properties of milk, and when mixed with water answers the same purpose.

that the quantity remaining in it is strictly confined to the 2 or 3 per cent., as above stated.

Having thus given the history of the beet-sugar manufacture, as conducted on the Continent, the question presents itself next, Whether it would be advantageous to introduce it into this country; not as an adjunct to the farm, as was attempted in France, and in every case proved a failure, but under the auspices of a company or firm, with adequate capital to carry it on upon an extensive scale, and with all the modern improvements and appliances, as it is now conducted on the Continent. We are aware that several attempts have already been made in England and Ireland to introduce it, all of which have failed. But having made myself acquainted with the history of each of these establishments, I am able to show that their failures were owing, not to the impossibility of making the manufacture profitable, but, in the first instance, to the conduct of the Government in suppressing it, and in the last, to the mismanagement and misconduct of those who had the oversight of the concern.

The first of these was established in Essex, by a respectable and well-known milling firm at Chelmsford. At that period (1832) the West India "Interest" was all-powerful with the Government; and there being no law to impose a duty on indigenous sugar—it never having been contemplated that it could or would be manufactured here—the "Interest" took the alarm, and prevailed upon the Government to interfere by imposing a prohibitory duty, which at once broke up the establishment. The proprietors, however, claimed and obtained compensation for the loss they sustained on the occasion.

About the same time a similar attempt was made at Hillsborough, near Belfast, Ireland, and it was under precisely the same circumstances as that in Essex—the absence of any duty on indigenous sugar, which previously was unknown in this country. The measures of the Government in imposing a prohibitory duty, as in the former case stopped the works. The proprietors were entitled, as well as Messrs. M., to compensation; but their demand upon the Treasury (about thrice the amount of their loss) was considered so extravagantly unjust, that it was indignantly rejected, and we believe that they never received a shilling from the Government.

In reference to these two attempts it is proper to state, that although, while there was no duty imposed upon it (that on colonial sugar being about 3d. per lb.) there was a large margin for a handsome profit, irrespective of the quality; yet so inferior was the article produced—half treacle and half candy—and so imperfect was the machi-

nery employed, that it was at once seen to be impossible to come into competition upon equal terms with West India produce, and the enterprises were therefore at once abandoned.

The third attempt was that of the Beet-sugar Company, formed in Ireland in 1850, under the most favourable circumstances, and with every prospect of a successful result, so far as the capabilities of the country for raising the raw material, and the perfection of the machinery employed, could insure it; but, however this may be, the enterprise failed through the folly of the beet-growers on the one hand, and the consummate dishonesty of those who had the management of the company's affairs.

The manufactory was established at Mount Melick, in Queen's County; and in respect to the soil and its adaptation for growing the beetroot, no district could have been better selected for a site for the plant. The premises, too, were suitable, but there appears to have been old instead of new utensils and machinery introduced by the engineers, and they were found to be so defective that they could not be worked: the consequence was, that the greater part had to be replaced by new works, at an expense that absorbed a large portion of the capital: for, notwithstanding the enthusiastic favour with which the introduction of the manufacture was received in Ireland, not 500 shares out of 20,000 had been taken by residents in that country, and the Board of Directors were all residents in London; Mr. John Gwynn, of British Bank celebrity, being the managing director of the company.

At length, after much delay, the factory was ready to commence working; but now arose another difficulty: The beet-growers, who had been supplied with seed gratis, under a written contract to sell the produce at a given price, refused to deliver it except at an advance of several shillings per ton. Their demand was rejected by the manager, upon which threatening letters were sent to him, and it was currently known in the neighbourhood that *Ribbon law* was to be administered to him. This, however, was averted by the spirited conduct of a large employer at Mount Melick—a *friend*—who signified to his numerous dependants that if any outrage was committed he would turn off every man in his employ. Through his friendly intervention, a compromise was effected with the farmers, and the factory set to work. A skilful superintendent from Valenciennes was employed, who certainly well understood his business; but, on the other hand, he managed the concern so much to his own advantage, that the whole of the working capital speedily disappeared; and the

factory was shut up. The finale was most disastrous to the shareholders, who were called upon to pay up in order to meet a deficiency wholly owing to the mismanagement and neglect of the directors and employes of the company. We believe, however, that a large portion of the loss fell upon the right shoulders, namely, the man who, assuming the management of the concern, retained the dishonest overseer long after his delinquencies had been denounced to him. The whole of the plant was afterwards sold by auction; and there being no one to purchase it for Irish or English use, it of course fetched but little. And thus concluded the third attempt to establish the beet-sugar manufacture in the United Kingdom.

Are we, then, to conclude from these failures that the manufacture of sugar from beetroot cannot succeed in this country? or that there are climatic or other natural obstacles to prevent its success? No such thing. It has been proved that at 45° of north latitude the beetroot contains amply sufficient saccharine power to render the manufacture profitable, and that the higher we advance the larger the proportion of that element. Now, the British Isles range from 50° at the Land's End, to between 59° and 60° at the Orkneys, and are consequently quite as well adapted to produce the Silesian beetroot with a sufficient amount of saccharine as any part of France or Germany—the former ranging from 42° to 51°, the latter from 44° to 55°, of north latitude. Besides, the cultivation of the beetroot is well known and understood here, although that of the Silesian variety has not received that attention from the English farmer for fattening purposes it deserves. It is otherwise on the Continent, where, such have been the efforts and skill of the farmers, that one of them has produced a new variety that contains 17½ per cent. of saccharine matter, being quite equal to that contained in the cane of the West Indies. This is wholly due to the sugar manufacturers, who have instituted experiments and combinations for its improvement. An association, called *Association pour l'industrie sucrière du Zolverein*, has been formed, composed of agriculturalists, manufacturers and men of science. The object is the promotion of the prosperity of the manufacture in the States of the Zolverein, and the increase of the proportion of saccharine in the beetroot. There are 240 sugar-works in those states, which in 1857, produced 110,000,000 kilogrammes (110, 000 tons) of sugar; whilst in the same year, 338 factories in France, made only 80,000,000 kilogrammes (80,000 tons). A very significant fact connected with this subject may as well be stated here, namely, that upwards of 30 sugar-works, which a short time since were con-

verted into distilleries, have again resumed the manufacture of sugar. We shall have occasion to revert again to this fact in speaking of that second branch of agricultural manufacture.

Resuming the subject of improvement: In Germany the Committee of Beet-sugar manufacturers have proscribed all inferior varieties of the beetroot, and allow only the cultivation of the very best kinds. The consequence is, that the German roots excel those of France in saccharine power to the extent of from 30 to 50 per cent. Another fact of a singular character has been elicited by the investigations, with respect to the juice of the beet, that in proportion to its density is that of the sugar it contains. Thus, a root whose juice weighs 5° Baumè, contains only 4 per cent. of real sugar, and 5 per cent. of foreign matters; whilst a root marked 10° Baumè, contains 15 per cent. of sugar, and only 5 per cent. of foreign matters. The perfection to which the root has been brought is evinced by the fact already stated. M. Knauer, a cultivator of Grobermur Halle, is the party who produced the variety, to which he has given the name of the *Imperial Beetroot*, and which contains 17¼ per cent. of the entire weight of the root of sugar. "He has arrived at this result," says the writer from whom I quote, "by a system of selection. He improves his variety from year to year, by attention and minute observation. He sells a certain quantity of this seed every year, and although its richness goes on increasing yearly, he reduces in an inverse proportion the price of his imperial seed. He began selling at the enormous price of 816 francs (£34) per 100 kilogrammes (2cwt.), and has now reduced it to 225 francs (£9 7s. 6d.) per 100 kilogrammes." The produce is small, but the intrinsic value of the root amply makes amends for any deficiency in the weight of the crop. Our English and Scotch farmers would do well to take a lesson from this German gentleman, who has proved the possibility of increasing, and even doubling, the amount of saccharine properties of this plant, which constitute its chief value, whether for sugar-making or for grazing.

This improvement will more than enable the maker of indigenous sugar to compete successfully with the West India planter. The cultivation of the sugar cane occupies from 12 to 15 months, and it must then be all manufactured *instanter*, and on the spot; whereas the beetroot requires only 130 days to arrive at maturity, and can then be stored and manipulated at any time. This is an important advantage the beetroot manufacturer has over the colonial, especially if there is any equality in the amount of produce. On this point, too, the following information is derived from statements by the

planters themselves, and is corroborated by other persons of undoubted authority on West Indian affairs.

In 1849 a Committee was appointed by Parliament to inquire into the question of the sugar duties. Before this committee several of the West India planters were examined *on oath*, and they all agreed that, although the cane contained from 16 to 20 per cent. of saccharine, not more than from 4 to 6 per cent. was obtained from it, although it is well known by scientific men that the whole of the saccharine is convertible into crystallised sugar. Since that period, improvements have been introduced into the machinery department, and it is probable that the proportion of sugar obtained is now larger—possibly 7 or 8 per cent. Still a large amount of saccharine is wasted and thrown into the fire with the megass or refuse of the cane. A considerable quantity of it is crystalised by the sun in the plant itself whilst ripening, and cannot therefore be extracted. The two manufactures, therefore, are much upon a par in respect to the quantity of sugar obtained from the two plants.

Dr. Davis, in his work on the West Indies, states that 100 hhds. of sugar, weighing 15cwt. each, cost 6672 dollars cultivating; and deducting 2000 dollars for the molasses, the sugar costs 14s. per cwt. To this must be added 4s. for freight and insurance, and 3s. landing, warehousing, and brokerage, &c. But besides this, the loss by drainage on the voyage is estimated at 2cwt per hhd., which makes the cost amount to 24s. per cwt., besides interest of money, and other incidental charges and deductions. These bring the cost of West India sugar much higher than that of indigenous sugar made from the beetroot on the Continent, which at the market price yields a good profit when manufactured in the best manner and upon a large scale.

There is no doubt, however, that the West Indian estates are capable of being worked to much greater advantage than is the present practice in Jamaica at least. In Barbadoes the planters have adopted the new scientific system, and are reaping the benefit of it in the increased amount and improved quality of the produce. In Demerara also, a spirit of enterprise has been evinced, and steam-power and machinery of the newest description introduced into the manufacture. Still the colonial sugar-planters labour under disadvantages and drawbacks, from which the European sugar-makers are free, and the latter will always be able to make a profitable trade when the West Indian is losing money.

Having thus given a history of the manufacture of indigenous

beet-sugar on the Continent, and its comparative advantage over that of Colonial sugar in point of profit, we shall now describe one which, although using the same raw material, is of a very different character in respect to its product. We refer to the distillation of ardent spirits from the beetroot and the potato, which has for some years been extensively carried on in several of the Continental countries; and, so far as profit is concerned, with great success, in some of them at least. An attempt has been made by a French firm (Messrs. Champonnois and Co.) to induce the English farmers to establish similar works in connection with their farms, and a model distillery was erected upon the best principle at Fulham. Fortunately the attempt was a failure; for assuredly it would have ended in the ruin of all persons concerned, and inflicted injury upon the agricultural interests of the kingdom, had it been extensively adopted. As the most favourable instance in which it has been so, we shall give a brief account of its rise and progress in Austria, where it has had a greater development than in any other country.

It was, we believe, in Austria that the idea of uniting the distillation of ardent spirits with the estates of the nobles was first suggested. It is a country so far isolated from the great grain markets of Western Europe, as to possess only one direct port, Trieste, at the head of the Adriatic, and the tedious route of the Danube, and the Black and Mediterranean Seas. On the other hand, at the period to which this paper refers (1830), there were no public roads or railways in Austria capable of assisting the farmer to convey his produce to market, except at such an expense as would have swallowed up the whole value. The long continuance of extreme low prices, after the peace of 1815 (with the exception of two seasons), reduced the Austrian landowner to the brink of ruin, and it was a question with them, whether they should abandon the cultivation of the land altogether, unless some mode were adopted of rendering the produce available by establishing agricultural manufactures. That of sugar was at once adopted; and nearly at the same time the idea of distillation was started as a last resource.

In many respects Austria is more favourably situated for the prosecution of these branches of industry than France, being the only Continental state (with the exception of Russia) in which the subdivision of the land has not been adopted. The estates of the aristocracy are very large, and although imperfectly cultivated, and

embracing a great extent of forest, the incomes derived from them are immense. Thus Prince Esterhazy can travel fifty miles from Vienna on his own property,* besides large estates possessed by him in Hungary and other parts. Austria also, is purely an agricultural country, although destitute, or nearly so, of the means of disposing of her produce beyond the home consumption. It was therefore easy, when once the change was determined on, for the landowners to establish the sugar-works, and distilleries upon an extensive scale; and this was in fact the case.

At first the distilleries were set to work upon grain, the price being at that time (1830) very low, and the foreign demand *nil*. But in a few years the corn market recovered its activity, and prices of cereal produce rose throughout Europe, so that it was found more profitable to employ potatoes on account of the largeness of the average produce. In 1857 there were 16,000 distilleries connected with the land in the Austrian dominions. The quantity of potatoes consumed, according to the statement in the *Journal d'Agriculture Practique* amounts to 1,250,000 tons annually, which, reckoning a produce of three tons per acre, requires an extent of land equal to 416,666 acres. The quantity of raw spirits extracted from them is 63,828,039 gallons (imp.), being 20 per cent. of the raw material. The residue is estimated at 462,203,028 gallons, and is employed in fattening cattle and pigs, for which it is well adapted. It is estimated that the above quantity is sufficient to fatten 60,000 head of cattle of the average size, the manure from which will amply suffice to dress 50,000 acres of land. This, however, falls far short of the land employed in the cultivation of the tubers, as above stated, which shows that the continuance of the system must, without a large addition of purchased manure, exhaust and deteriorate the soil.

It is assumed by the advocates of the system that these two manufactures have alone saved the landed interest of Austria from utter ruin. This may have been the immediate effect resulting from it, but whatever advantages the land owners may have derived from it—and they certainly have been enriched by it—the effect is injurious both to the occupiers of land and to the country at large,

* Prince Esterhazy has immense flocks of sheep on his estate. The writer was present at the Holkham sheep-shearing in 1808 or 1809, when the Earl of Leicester, (then T. W. Coke) introduced the Prince, and referred to his being a large flock-master, upon which the Prince offered a bet of ten guineas that he had *more* shepherds than Mr. Coke had sheep. The bet was accepted, and upon receiving the account subsequently from the steward, or head shepherd, the Prince won the bet by one shepherd over Mr. Coke's flock. The Prince is still living, and the writer was recently informed by Mr. Smallbones, his consulting steward, that his present flock consists of 250,000 sheep, besides lambs.

by the exhaustion of the soil, and the diversion of capital from its improvement, to the pursuit of a branch of industry certainly not the best calculated to promote the material prosperity; nor is it a less favourable feature that the attention of the husbandman is divided between two incongruous occupations, which, although dependent the one on the other for success, were never intended to be united. The proof of the injury sustained by agriculture from the system is to be found in the smallness of the return of the three cereal crops (wheat, barley, and oats), which, taken together, does not average more than four and three-fifths of the seed sown; and by the inattention manifested of late years to the races and breeding of cattle and sheep.* The temptation of an immediate profit, and a certain market for their potatoes and beet-roots, has led the farmers to neglect the more important cultures, to the destruction of good farming, and, as a consequence, the material prosperity of the country.

But the system adopted by the great Austrian distillers for the disposal of these spirits is still more injurious to the welfare of the country. Having contracted with the farmers for the growth of a certain extent of potatoes, they advance money to them, and also spirits. Every inducement is held out to them to purchase this latter, upon the faith of the growing crop, and the consequences prove most injurious both to the moral and physical character of the rural population. A French writer (M. Mario), himself an advocate for the principle of agricultural distilleries, has borne the following testimony to its effect in Austria. "As to the consequences of the inordinate use of alcohol, they speak for themselves. Galitia exhibits an example which deserves to be studied; and they have been amply exposed and brought to light in the publications of those authors and temperance societies who have undertaken to struggle against the use of alcoholic liquors."

With regard to the attempt to introduce the system of agricultural distilleries into the United Kingdom, although hitherto it has proved unsuccessful, and the last two seasons have proved adverse to the profitable working of the system, we have reason to believe that another attempt will be made to overcome the scruples of the Eng-

* Notwithstanding that Austria possesses the finest grazing lands in Europe, the supply of butcher's meat is much below the consumption, and it requires an importation to the amount of one million sterling to supply the deficiency. Even the breeding of horses is now very little attended to, as well as of cattle, which is carried on without any regard to excellency of race. The breeders are said to be guided in their choice by size rather than form and symmetry.

lish farmers, and to induce them to adopt it. We shall point out the evils that would, as we believe, inevitably attend and follow its adoption.

In the first place, by absorbing a large amount of the capital now engaged in agriculture, the means of the farmer would be restricted, and the improvement of the land retarded; whilst, by the distraction of his mind between two incongruous employments—both of which, to be successful, requires an individual attention—he would generally lose that steadiness of character which has been one of the principal means of his success. Whatever temptation there may be in seasons when low prices prevail, to deviate from the regular cultivation of the land, and to divert it in part, and the capital employed, to manufacturing purposes, for the sake of an immediate advantage, the return thus obtained would not compensate for the injury that would be permanently inflicted upon the land, and, therefore, upon the occupier in the deterioration of the soil, as in Austria.

But, however profitable this system may, at its commencement, prove to the distiller, its extension would certainly prove ruinous to all engaged in it. The increased supply would inevitably lower the price of the produce till it yielded no profit, or even left a loss. This has actually been the case in France, where, for the last two years, most of the distilleries have been stopped on that account; and all the efforts of the Champonnois party to make out that they yielded a fair profit, have failed to convince those who actually suffered a loss on the working. The fact, too, that in the states of the Zolverein upwards of thirty works that had been changed from the production of sugar to that of alcohol have again reverted to the first purpose, is too significant to require any comment.

SCIENTIFIC AND LITERARY NOTES.

GEOLOGY AND MINERALOGY.

COAL DEPOSITS OF BRITISH COLONIES IN THE SOUTH.

(From the Mining Journal of April 27, 1861.)

"Among the numerous mineral products that will be shown at the International Exhibition of 1862, there can be none of greater interest than the samples of coal. Every information as to quality, extent of deposit, facility of working, and market price, with statistics of the quantity mined, will be of great importance. The supply from our own coal beds at home is indeed enormous, and the export trade, as we have already shown, considerable; but the economic

products of coal are every day being enlarged by obtaining oil, dyes, and other chemical products therefrom. The great extension of steam navigation, ocean and coasting, the increase of steam motive-power for manufactures and machinery of various kinds, the demand for coal in different quarters for illuminating purposes, and even for fuel in many of our rapidly progressing colonies in Africa, Australia, and the East, render the more general discovery and working of fossil fuel in those dependencies of immense importance to their future successful advancement. Fortunate, therefore, is it that coal exists in our South African colonies, in New South Wales, Victoria, Tasmania, and New Zealand; in Labuan, Nova Scotia, New Brunswick, and Vancouver. In many parts of British India, too, coal has been discovered and successfully worked. Although the supply of this valuable mineral is no doubt illimitable, yet with the extension of trade and settlement, of manufacturing industry and steam navigation, it may be useful to point out the various and increasing sources of supply, and to direct more prominent attention to them in a commercial point of view. Analyses of the special qualities of the coal would also be especially useful.

It is chiefly within the last quarter of a century that the immense increase in the factories of England, in her railways, steam-vessels, steam engines, gasometers, and foundries, have rendered coal of such great value to the advancement of our country's commerce, comfort and civilisation. In the year 1772, Pennant gave as a grand feature in the national commerce that 351,890 chaldrons of coal were shipped that year at Newcastle, of which about 260,000 chaldrons formed the London supply. Now the export from that port to London alone reaches 1,250,000 tons; the foreign exports exceed 7,300,000 tons; while the annual produce in the kingdom amounts to nearly 70,000,000 tons. A consideration of these figures will serve to convey some idea of the immense present and daily increasing consumption of coal. Coal is the indispensable aid to all industrial progress; and even in this metropolis we require now about 5,000,000 tons annually.

In the Cape colony deposits of coal have been found near Burgher's Dorp, and on the surfaces of several farms in the Albert district, but is too high in price to warrant much being done with it; 3s. being the lowest price paid for a muid, or sack of 2¾ bushels. It is of good quality, and burns well, but being taken from the surface is not so good as that obtainable by digging to a depth of some feet, an experiment which the Dutch farmers are loth to try, on account of the trouble. Some specimens obtained by digging are stated to have been found equal to many descriptions of English coal. It is found of a fair quality in the hills to the north of the Tugela River; and anthracitic coal, probably as good as that in general use in the United States, is in considerable quantities near Washbank and Sunday Rivers. This coal, in other parts of the world, has lately acquired a considerable degree of importance, and a high value, being almost pure carbon, and burning without smell or smoke. There is also coal found in Natal of excellent quality, of the ordinary bituminous description, in the ravines between Biggarsburg and Umzinyati River, 63 miles only distant from Maritzburg, the capital; and there is another in a small river near Biggarsburg, in lat. 28° 7′, long. 29° 25′, which is intersected by a vein of trap. Bishop

Colenso speaks of coal being found in Natal in abundance, and of the finest quality, but as yet too far from the sea coast, with the present means of land carriage, to make it worth while to transport it in large quantities. At a farm-house on the Tugela, the Bishop saw excellent bituminous coal, the produce of the colony, which cost nothing where it was found, but which sold for £5 the ton at Maritzburg, from the great expense of transit. In county Victoria, to the north of Durban, there is a place on the sea shore where a vein of coal crops out, and is quarried and used by the neighbouring sugar-planters. It is a surface coal, and, of course, the quality of a lower stratum would be, in all probability, vastly superior.

The Borneo and Labuan coal is chiefly absorbed in China and Singapore. The Labuan coal is of excellent quality, and lies so near the sea that it can be carried on board ship from the pit's mouth. There seems, however, of late years, to have been some stoppage in the company's operations; for, while 5530 tons of coal were sold from the mines there in 1856, the sales dropped to 1100 tons in 1857, and in 1858 there were no sales at all. Whether this arose from want of labor, or from some other cause, we cannot learn.

In New South Wales, the Australian Agricultural Company are in possession of a valuable coal field at the south entrance of Port Hunter. In 1836 the total amount of coals raised in the colony was but 12,646 tons, which had increased to 67,660 tons in 1851, and 216,397 tons, of the value of £162,182, in 1854. This quantity was obtained from nineteen coal mines. The high price of labor has somewhat stayed the progress of colliery operations. The whole area of this great Australian coal field cannot be less than 16,000 square miles; much of this is situated at too great a depth for profitable working, but at Newcastle, and on Hunter River, it crops out to the surface in seams of from four to ten feet in thickness. The Rev. W. B. Clarke, a geologist of repute, states that from his own surveys and actual knowledge, as compared with its gold fields, the carboniferous portion of New South Wales is of infinitely greater value. It has been said of North America that "no part of the known world offers so great a development of carboniferous rocks;" but Australia presents a close parallel with that rich coal-bearing region, and there are enormous areas of tens of thousands of square miles occupied by these carboniferous ore beds in New South Wales and Queen's Land. Several workable and valuable coal seams exist on the Bremer and Brisbane Rivers, and along the shores of Moreton Bay. On the Brisbane River steamers can load by lying literally at the mouth of the mines, as is the case at Lake Macquane; this phenomenon is characteristic of the coal of New South Wales. In the colony of Victoria veins of coal of superior description have been found in many localities—Western Port, Gipps Land, Moonlighthead Coast, and other places. There is also a field extending from the Barrabool Hills to Cape Otway, which presents many characteristics similar to that of Western Port. In both those fields the only seams of coal of workable thickness have been found on the sea shore between low and high-water mark. The place where the coal crops out, on the Cape Otway shore, is within four miles of Loutit Bay; and in respect of proximity of harbour has the advantage over the Western Port field. Coal has also been discovered at Cape

Patterson, about 150 miles from Melbourne, on the south-east coast. A good workable coal field would be of the greatest importance to Victoria for the operations of its railways, factories, and steam-vessels. In South Australia the geological formation at Mount Gambia holds out the promise that coal might be found in abundance in that district by means of the needful appliances, properly directed. Coal is reported to exist in considerable quantities at King George's Sound, Western Australia; it is said to cover a space of 30 miles, and to commence at Doubtful Island Bay, close to the sea shore. There is also a good coal stratum on the Preston, near that colony. A fine field exists in the north at 28°57' south latitude, and 113°30' east longitude. The mine is 45 miles from Champion Bay, 42 miles from the mouth of the Irwin, and about 200 miles north of Perth.

The whole island of Tasmania is interspersed with coal formations, either bituminous or anthracitic, and labor alone is required to secure good and cheap fuel. Mining operations have been carried on in the island on a small scale. It requires something more than a mere acquaintance with the mechanical processes of mining in pits that have long been worked, to open new seams, and direct the necessary operations for extracting the mineral without waste or injury, so as to send it to a profitable market. The demand for coal that now exists in Australia, and is likely to grow every year, is far in excess of the requirements of the colonies prior to that accession of population and expansion of commerce in all its branches which was occasioned by the gold discoveries. The timber supply hitherto depended on for fuel in all the great centres of population is partially exhausted, and we have already shown the extensive use that has sprung up of steam-power in machinery and locomotion both on land and sea.

"No reasonable doubt can be entertained," writes Dr. Milligan in his very elaborate Report on the Coal Fields of the East Coast of Tasmania, "that for all practical purposes of the present day, an inexhaustible supply of good coal exists at Mount Nicholas and Fingal. Whether it may be profitable to send it to market, or practicable to consume it productively on the spot, is for capitalists and speculators to consider, and probably for unforeseen circumstances to decide." These words were written in the year 1848. At that time Melbourne was a small village, and the River Yarro and Hobson's Bay frequented only by a few ships, taking home their annual cargoes of tallow and wool, the early, and for many years the only, staples of the district of Port Phillip, now become the important colony of Victoria. The gold fields were undreamt of; the interior of the country unoccupied, except by sheep runs; and the River Murray and its tributaries unexplored, while they are now traversed by steam-boats. At that time railroads were unknown in Australia; steam-machinery had no place, save in the shape of an occasional flour-mill, and none of the great ocean steamers, which now serve the uses of a developed commerce, had visited the Australian waters.

It seems, therefore, an opportune time to call attention more prominently at home to the vast deposits of coal that are lying unused in many of the southern colonies, to stimulate further examination and to throw together a few notes with respect to existing information and enquiry on the subject. Dr. Milligan,

whose report gives proof of a very careful survey and inspection of what he terms "the magnificent coal seams of the east coast," says they extend over a large area. Of the quality of this coal, he states in general terms that "it is first-rate, and will be found equal to any or all of the purposes to which the best English coal is applied." He says, again, "the coal is of the finest quality, of a deep black colour, with a rich, bright, and splendent lustre, like that of resin or jet. It is easily frangible, and ignites readily, burning in the mass with a wild ruddy flame, and a strong glare." In the immediate vicinity of Fingal lies the Steiglitz coal field, at a very practicable distance from the two shipping places of George's Bay and Falmouth. Steiglitz main stream, in the Mount Nicholas range, which is twelve feet in thickness, is a distance of twelve miles from the sea by a road already made.

The island of Tasmania resembles Wales in the character and position of its coal, which is anthracite in the southern part of both countries. Extending northerly, it gradually loses that character, by becoming semi-bituminous. It is, however, important for colonial interests that the use and value of anthracite coal should be properly made known. Mr. Taylor, in his "Statistics of Coal," states "that the researches of scientific men have proved that anthracite coal was formerly bituminous, having been deprived of volatile matter by the action of internal heat; leaving a greater amount of carbon, the excess of which stamps the value of coal for general purposes, except in the manufacture of gas;" and he adds that in the smelting of ores anthracite is preferred to bituminous coal, which cannot be used in the furnace in a crude state, but must first be converted into coke. Anthracite coal is obtained on Schonter Island, on the coast, where vessels may anchor within 200 feet of the coal pit. The seam is from six to seven inches thick, and consists of layers of anthracite, of a porous and coke-like character, with small layers in succession of bituminous coal. The miners state that they could afford to deliver it at the water's edge for 4s. or 5s. per ton. At South Cape a seam from eighteen to twenty inches thick is found, but not worked. The coal is highly carbonaceous, but largely mixed with iron pyrites. At Richmond it crops out on the west bank of the Coal River, about one mile from a point on the estuary where vessels of twenty tons may load. The seams vary from two to two and a half feet in thickness. At Newtown, within two miles of Hobart Town, the capital, anthracitic coal is obtained in six shafts, at depths varying from thirty-five to eighty feet, and the supply sent into town is considerable. It sells from 25s. to 27s. per ton. At Tasman's Peninsula, known in market as Port Arthur coal, it has been worked largely for nearly thirty years, and, though a coarse anthracite coal, it throws out great heat, and is much valued for furnaces. It sells from 30s. to 35s. per ton. Bituminous coal is found at Douglas River, on the north-east coast, about four miles from the sea. Some of the seems are eight feet thick, and so close do they often run to the surface that in a fifty-feet shaft six seams of coal were cut. A seam of twenty inches has been worked for the Hobart Town market, where the coal is sold at 30s. to 40s. per ton. In the interior this coal crops out in the bed of the Ouse River, where the seam is four feet thick, under a four-feet bed of pipe-clay. Bituminous coal is also obtained in the North, at

the Mersey, on Port Frederic, the seams being from two to three feet thick. On the River Don, in the same neighbourhood, it crops out of the earth in many places from twenty-six to thirty inches thick, and this coal is stated by Mr. Selwyn to be the best in the island. In two places where shafts have been sunk, twenty-seven inch seams have been found less than twenty feet from the surface. For many of these particulars we are indebted to the official colonial reports of Dr. Milligan and Mr. Selwyn, both eminent geologists.

An extensive bed of shale has been found at the great bend of the River Mersey, near La Trobe, which is estimated to cover 490 acres, and to have a depth of from eighteen to twenty feet, equal to a quantity of 20,000,000 tons. Making, however, a liberal allowance for waste, and for walls to support the ground in mining, it is calculated that at least 10,000,000 tons might be quarried and mined with ease. This shale is found close to the surface. Where it has been exposed to the atmosphere it is of a light brown colour, but taken from a greater depth it is of the colour of dark grey; and a small piece of it the flame of a candle lights easily and burns brilliantly. The extraction of oil from shales and coal has been largely extended of late years, not only in the United Kingdom, but in France, Germany, and the United States. The demand for lubricating oil on railways, and in machinery, and for many manufacturing purposes, is constantly increasing. Its great recommendation consists in the fact that it remains limpid and pure after exposure to the atmosphere, and never thickens or clogs on the machinery, as ordinary oils do. The manufacture of this oil is not attended with any difficulty that would prevent its becoming a colonial industry. The process is very simple, at least as much so as the manufacture of gas.

In New Zealand much enterprise has lately been displayed in coal mining, a matter of some importance now that there are so many coasting steamers, intercolonial steam-vessels running to Sydney and Melbourne, and that a Pacific line is projected thence to Panama by the Otago Government. At the Motupipi coal field the fuel improves as the seam is worked; the coal is rather sulphurous, and burns rapidly, leaving a good deal of ash, but does well for steamers, if mixed with an equal quantity of English coal. At Pakawan coasters can load coal, but vessels above 200 tons have to load in the offing, or at the Pata Islands.

The preliminary step to all manufacturing enterprise is the development of the coal beds where they exist. The furnace and the steam-engine are the great industrial forces of the age; and to these coal is the staff of life. That many of our principal colonies possess this substance in abundance, should satisfy them more than if they had great gold fields. With it they can create gold by direct exchange, and by manufacture. Both by exporting the produce of their mines, and by using it in the creative processes of manufacture, they have it in their power to make a vast addition to their public wealth, and greatly augment their capability of supporting an industrial population. The collection of samples or foreign coal may be made one of the most interesting in the Exhibition, having regard to its important uses. Full details with respect to the seams, accompanied by maps and geological sections and reports, statistics of production, existing for land transport or shipment, and authentic analyses,

would render the collection a medium of reference of the highest interest. Especially should samples of all varieties from different localities be placed side by side for comparison, independent of the special colonial collection of objects of which they would form a part.

We have confined our observations here to the coal deposits of our southern colonies, but will direct attention hereafter to those important coal fields we possess in the western world.

NOTES ON CANADIAN CHLORITOID.—BY T. STERRY HUNT, F.R.S.

(From the American Journal of Science and Arts, May, 1861.)

"Among the crystalline Palæozoic schists of the Notre Dame Mts., which are the Canadian prolongation of the Green Mts., of Vermont, is a rock characterized by the presence of a mineral which has been designated in the Reports of the Survey by the name of phyllite, from the supposition of its identity with a similar mineral from Massachusetts, described, named and analyzed by Thompson. The mineral in question is abundant in a fine grained grayish wrinkled micaceous schist from Brome, and in larger specimens from Leeds; where it occurs in a similar rock which is pearl gray in colour, passing into greenish gray, and contains a large proportion of quartz with a mineral talcose in aspect, but aluminous in composition, and apparently micaceous. Similar micaceous schists containing the mineral in question may be traced in the continuation of the Notre Dame Mts., as far as Gaspé. In the rock of Leeds the phyllite occurs in small lamellar masses rarely more than one-fourth of an inch broad and one-eighth of an inch thick. In some specimens it forms spherical aggregations half an inch or more in diameter composed of radiating lamellæ and sometimes making up one-half the volume of the rock. In most localities however the masses are smaller and less abundant. The mineral has a perfect cleavage in one direction and two less distinct transverse cleavages, 'the lamellæ are often curved and are not easily separable. Hardness 6·0, density 3·513, colour dark greenish-gray to black; brilliant black on the surfaces of perfect cleavage, which have a vitreous lustre; the cross-fracture is granular and exhibits a feeble waxy lustre. The streak and powder are greenish gray. The mineral resembles somewhat a dark coloured variety of hypersthene.' The analysis of a carefully selected specimen from Leeds gave as follows:*

Silica	26·30
Alumina	37·10
Protoxyd of iron	25·92
Protoxyd of manganese	·93
Magnesia	3·66
Water	6·10
	100·01

This analysis shows the mineral to be chloritoid, with which its specific

* Report of Geol. Survey of Canada, 1858, p. 194.

gravity and other characters agree. It is the *barytophyllite* of Breithaupt, the *masonite* of Jackson and the *sismondine* of Delesse. All of these minerals occur in argillaceous, micaceous or chloritic slates and having a hardness of 5·0—6·0, and a density of 3·45—3·57. have been united with chloritoid, with which they agree in composition. (Dana, *Mineralogy*, ii. 298.)

The phyllite of Thompson, according to the analysis of that chemist contains a larger amount of silica than chloritoid together with more manganese, and 6·80 p. c. of potash, but having had occasion to repeat several analyses of this chemist, I have found that his determinations of alkalies are entirely erroneous. Thus in the case of raphyllite a tremolite containing only traces of alkalies, he indicated more than ten per cent of potash and in his retinalite, a pure serpentine, nearly nineteen per cent of soda.* In both cases the error was at the expense of the magnesia of the mineral. The substance examined by Thompson has not so far as I know been examined or identified by American mineralogists, but in the mineralogical cabinet of Laval University at Quebec, is a specimen from the collection of the late Mr. Heuland; said to be phyllite from Massachusetts, which is evidently chloritoid, and cannot be distinguished from the specimens of that mineral just described; the rock is also apparently identical.

The ottrelite of Haüy, to which Dana has referred the phyllite of Thompson, occurs in an argillaceous slate in Belgium, and in a specimen before me cannot be distinguished from the phyllite from Massachusetts or the chloritoid of Canada. This mineral has however been analyzed by Damour, whose name is a guarantee for accuracy, and differs from chloritoid in containing a considerable excess of silica, which might possibly be derived from the gangue. The specific gravity which Damour has assigned to ottrelite is 4·4—which is so extraordinary for a mineral of that composition that we are led to suspect some error probably of the press or pen. The question of the identity of ottrelite with chloritoid is one which requires farther examination. Meanwhile the latter mineral assumes some importance to the lithologist as characterizing over wide areas considerable masses of schists, which we have elsewhere described as chloritoid slate."

NOTICES OF BOOKS, &c.

Lovell's General Geography. By J. George Hodgins, LL.B., Quarto, pp. 100, with numerous maps and illustrations. Montreal, J. Lovell; Toronto, R. & A. Miller. 1861. It must be well known to all engaged in the duties of tuition, that works compiled essentially for teaching purposes rarely succeed in meeting all the requirements of their special cases. Something is generally omitted or but slightly touched upon in this place, or too much elaborated in that; and treatises in which one would least expect it, are often made a vehicle for the

* Report of Geol. Survey of Canada, 1850, p. 40.

expression of partial or peculiar views. It is therefore with the greatest satisfaction that we call attention to the very ably compiled and exceedingly well got up manual, entitled "Lovell's General Geography." Both author and publisher merit the warmest commendations. Although intended mainly for primary schools, and thus illustrated with numerous engravings of characteristic animals, important cities, &c., most useful in fixing the attention and aiding the memory of the young—the work, from its careful condensation and statistical and other tables, may be consulted with profit as a book of reference by those who have long bid the schoolmaster good-bye. The engravings are far in advance of those with which elementary geographical works are usually supplied; and the views, judging from sketches of some twenty or more European and American cities with which we are well acquainted, are really fair representations of what they profess to be. The maps likewise, although necessarily upon a small scale, are amply sufficient for general purposes. We may therefore truthfully recommend this School Geography as the best and most useful manual of its kind that we have yet met with.

On the Pre-Carboniferous Flora of New Brunswick, Maine, and Eastern Canada. By J. W. Dawson, LL.D., F.G.S., &c. In this important communication, reprinted from the *Canadian Naturalist* for last May, Professor Dawson describes various new species of land plants from Lower and Upper Devonian rocks of this continent; and he gives in conclusion a general summary of the pre-carboniferous genera and species at present discovered in British America and the State of Maine. The land plants, of which thirteen or fourteen are due to Dr. Dawson's own determinations, amount to about twenty-one species. These according to the author, belong to the Coniferæ, Sigillariæ, Calamiteæ, Asterophylliteæ, Lycopodiaceæ, and Filices. Of the latter (Ferns) only two species, *Cyclopteris Jacksoni*, Dawson, and an undetermined *Sphenopteris*, are known. The Calamiteæ furnish also but one form, the *Calamites transitionis* of Goeppert, likewise met with in the Devonian beds of Silesia, and in the Lower Carboniferous rocks. By adding to these the Devonian flora of New York and Pensylvania, the list of species, all belonging to Cryptogamous or Gymnospermous types (Dawson), amounts to about thirty. Professor Dawson observes however, that additional forms have been discovered in New Brunswick subsequently to the drawing up of his paper.

The Metals in Canada: A Manual for Explorers, &c. By James L. Willson and Charles Robb, Mining Engineers. 12mo. pp. 81. Montreal: Dawson and Son, 1861. The compilers of this little work have just established themselves as mining engineers in Montreal, and they take this method of introducing themselves (in this capacity at least, for otherwise they are well-known) to the notice of the Canadian public. The work treats usefully of the various conditions of occurrence of metalliferous deposits generally, and gives directions for the carrying on of preliminary and other explorations with regard to these. It contains also brief notices of the more common metallic ores and economic minerals, with some hints on the chemical examination of these bodies. A few inadvertencies have crept into the compilation, such as that which states that

"iron cannot be reduced to the metallic state by the blowpipe, whilst all other metals (except manganese) can;" but, passing over these, the work will be found useful to land-owners and others interested in mining pursuits.

Sur l'Unité des Phénomènes Géologiques dans le Système Planétaire du Soleil. Par L. Sæmann. Paris, 1861. A notice of this interesting memoir will appear in our next Number.

Tables of Measures: English, Old French, and Metrical. By Arthur Wurtele, Provincial Land Surveyor and Civil Engineer. Montreal: B. Dawson and Son. 1861. In this useful little brochure, a series of Tables of corresponding French and English weights and measures, amounting to thirty-three in number, are given in a portable and convenient form. These tables should find a place in every engineer's and surveyor's office. In the Lower Province more especially, where the old French measures are still obstinately retained in spite of the modern system, they will be found quite indispensable, and will meet undoubtedly with a ready sale.

Journal of Education: Lower Canada. Our best thanks are due to the able conductor of this Journal for the regular transmission of copies. We hope to notice more fully in another issue the volumes for the present year, and in the mean time we may sincerely congratulate their editor on the success which has attended his efforts in promoting the cause of education in the Eastern Province.

Remarks on Upper Canada Surveys, with Extracts from the Surveyors' Reports, containing a description of the soil and timber of the Townships in the Huron and Ottawa Territory. Appendix No. 36 to the Report of the Commissioner of Crown Lands for 1860. Quebec, 1861. In issuing this Report in an easily accessible shape, the commissioner of Crown Lands has acted most judiciously. It contains a large amount of valuable information on the newly arranged districts of the Huron and Ottawa Territory, and it is furnished in addition with a carefully prepared map. Intended settlers and others interested in this extensive region, will do well to procure copies without delay. The notices of the townships are briefly and clearly given, and are confined to really useful details—describing the soils, minerals, timber, streams, mill-sites, and other matters of practical interest. For the copy kindly sent to us, we are indebted to Thomas Devine, Esq., of the Crown Lands office, by whom the map which accompanies this Report, has been compiled.

Map of the United Counties of Prescott and Russell. By J. S. Abbot Evans, P.L.S. This valuable map, of which a copy has been forwarded by Mr. Evans to the Canadian Institute, shews in addition to general topographical features, the positions of all the town-halls, post-offices, schoolhouses, mills, and more mportant inns throughout the area embraced within its Survey, thus rendering it of more than ordinary utility.

Other publications, received at a late date, will be noticed in our next issue.

E. J. C.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—JUNE, 1861.

Latitude—43 deg. 39.4 min. North. Longitude—5 h. 17 min. 33 sec. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°. 6 A.M.	2 P.M.	10 P.M.	MEAN.	Temp. of the Air. 6 A.M	2 P.M	10 P.M	ME'N	Excess of mean above Average	Tens. of Vapour. 6 A.M	2 P.M	10 P.M.	M'N	Humidity of Air. 6 A.M	2 P.M.	10 P.M	M'N	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Resultant Direction.	Velocity of Wind. 6 A.M	2 P.M	10 P.M	Result.	ME'N	Rain in Inches.	Snow in Inches.
1	29.804	29.771	29.738	29.7670	49.7°	64.5°	54.4°	57.82°	+ 0.87°	.278	.262	.308	.273	.77	.43	.72	.60	Calm.	S S W	Calm.	S 45° E	0.0	1.0	0.0	0.60	1.35	...	...
2	.728	.628	—	—	50.4	64.1	—	—	—	.299	.435	—	—	.81	.73	—	—	N E b E	E b S	E S E	S 56 E	1.0	4.5	3.0	3.03	5.15	0.541	...
3	.286	.366	.400	.3912	64.5	73.1	64.1	66.93	+ 9.38	.532	.499	.473	.497	.88	.61	.78	.76	S W	N W b W	N N W	N 65 W	10.0	29.4	6.0	10.68	15.04	...	...
4	.616	.649	.685	.6520	53.3	54.0	49.0	52.20	— 5.65	.291	.292	.264	.278	.71	.69	.76	.71	N N E	S E b E	E N E	N 88 E	5.2	8.6	4.5	6.77	7.72	...	...
5	.692	.673	.686	.6763	51.8	51.5	49.3	51.10	— 7.05	.208	.274	.293	.260	.53	.71	.83	.69	E N E	E b N	E N E	N 75 E	17.2	20.5	6.0	11.63	11.66	0.598	...
6	.702	.716	.685	.6992	51.1	60.1	51.8	54.47	— 3.98	.342	.388	.310	.348	.91	.74	.80	.81	E N E	E S E	E N E	N 80 E	2.0	6.8	1.7	3.22	4.11	...	...
7	.686	.701	.691	.6948	54.7	66.6	55.1	58.68	— 0.07	.358	.479	.398	.403	.84	.73	.91	.82	N b E	S b W	Calm.	N 52 E	4.8	6.0	0.0	0.73	3.94	Inp.	...
8	.717	.705	.717	.7105	60.5	71.3	68.1	67.60	+ 8.53	.349	.442	.511	.437	.66	.57	.75	.64	N N W	S W b S	Calm.	N 16 W	9.2	1.5	0.0	4.08	5.19	..	...
9	.708	.691	—	—	68.8	86.5	—	—	—	.359	.306	—	—	.51	.24	—	—	N b W	N N W	N N W	N 20 W	3.3	10.0	13.5	9.74	10.08	..	...
10	.690	.591	.540	.6007	64.5	80.3	71.0	72.22	+12.43	.480	.596	.528	.516	.78	.58	.69	.65	W b N	S W b S	N N W	N 35 W	1.0	4.0	2.8	3.72	4.42	...	...
11	.531	.436	.348	.4317	61.6	78.9	71.7	72.40	+12.42	.441	.627	.477	.549	.81	.63	.60	.69	Calm.	S S W	W b S	N 76 W	0.0	4.3	1.0	3.68	4.94	0.006	...
12	.413	.465	.548	.4847	64.1	72.4	58.3	65.00	+ 4.73	.399	.364	.355	.375	.66	.46	.73	.61	W N W	N W	N W b W	N 49 W	13.5	19.0	14.2	15.05	15.31	...	...
13	.692	.709	.733	.7203	54.5	64.6	54.4	57.90	— 2.68	.307	.228	.308	.286	.72	.37	.73	.61	N N W	N W b N	N b E	N 35 W	14.0	12.8	0.4	4.75	5.62	...	...
14	.731	.628	.406	.5777	51.5	59.8	52.6	55.28	— 5.55	.274	.347	.321	.315	.71	.67	.80	.72	Calm	E	N E b N	N 83 E	0.0	1.8	6.5	2.10	2.46	0.140	...
15	.284	.208	.216	.2283	58.7	73.1	65.5	65.42	+ 4.28	.442	.627	.455	.520	.90	.78	.72	.83	S W b S	S W	N W b W	S 71 W	3.0	8.3	14.2	5.98	8.10	0.191	...
16	.280	.490	—	—	60.9	64.5	—	—	—	.450	.308	—	—	.85	.51	—	—	N N W	W N W	N N W	N 14 W	11.8	15.8	11.5	14.11	14.33	...	...
17	.706	.713	.677	.6998	49.0	58.7	51.8	54.08	— 7.57	.197	.272	.300	.253	.55	.55	.78	.60	N b E	S S W	Calm.	S 13 E	10.5	5.0	0.0	0.26	2.94	..	...
18	.626	.562	.498	.5487	48.6	58.3	54.4	54.60	— 7.35	.249	.344	.298	.308	.72	.70	.69	.71	Calm.	S W b S	S W b W	S 30 W	0.0	3.0	0.5	1.58	1.63	Inp.	...
19	.512	.434	.447	.4718	53.6	70.2	64.1	61.98	— 0.15	.308	.538	.524	.452	.74	.73	.87	.80	Calm.	Calm.	N W	N 55 W	0.0	0.0	6.8	2.73	4.85	0.299	...
20	.576	.625	.570	.5780	58.0	65.6	54.7	60.33	— 2.12	.360	.453	.358	.389	.74	.71	.84	.74	N	S b W	E S E	S 86 E	11.0	6.6	1.0	1.78	5.42	0.312	...
21	.333	.314	.434	.3682	54.4	69.2	56.2	59.12	— 3.55	.396	.498	.360	.406	.93	.70	.80	.81	E N E	W b N	Calm.	N 70 W	6.6	13.2	0.0	3.87	5.68	...	...
22	.453	.418	.437	.4357	56.5	78.2	63.4	66.75	+ 3.80	.390	.365	.334	.371	.85	.37	.57	.60	W	W	Calm.	N 76 W	2.0	16.0	0.0	6.12	6.62	...	...
23	.384	.400	—	—	54.0	70.2	—	—	—	.362	.233	—	—	.87	.31	—	—	Calm.	N	N N W	N 33 W	0.0	16.0	8.5	8.02	8.87	0.038	...
24	.652	.635	.622	.6338	54.4	66.3	57.3	59.68	— 3.57	.298	.343	.335	.321	.69	.53	.71	.63	Calm.	S b W	S b W	S 76 W	0.0	7.0	1.0	3.26	3.33	...	...
25	.667	.599	.493	.5710	60.5	68.8	63.7	64.35	+ 0.80	.408	.424	.440	.428	.77	.60	.75	.71	Calm.	S E b E	Calm.	S 55 E	0.0	4.6	0.0	1.56	2.16	...	...
26	.340	.448	.591	.4700	67.0	78.5	62.3	68.97	+ 5.08	.539	.347	.325	.398	.82	.35	.58	.58	S W b W	W b N	N N W	N 68 W	6.0	16.4	8.4	8.38	9.24	Inp.	...
27	.708	.623	.640	.6537	55.4	69.5	60.1	62.30	— 1.77	.339	.428	.401	.399	.76	.59	.77	.71	Calm.	S S E	Calm.	S 39 W	0.0	4.3	0.0	3.20	4.01	...	...
28	.627	.586	.610	.6063	58.3	69.5	56.5	61.52	— 2.77	.367	.428	.270	.344	.75	.59	.59	.62	Calm.	S S E	Calm.	N 86 W	0.0	1.2	0.0	1.14	2.56	Inp.	...
29	.633	.564	.538	.5742	54.4	69.5	57.2	61.58	— 2.87	.287	.351	.304	.311	.67	.48	.64	.57	Calm.	S S E	Calm.	S 18 W	0.0	7.2	0.0	3.40	4.32	...	...
30	.482	.408	—	—	59.4	65.2	—	—	—	.398	.497	—	—	.78	.80	—	—	Calm.	S W	Calm.	N 13 W	0.0	2.5	0.0	1.12	2.23	0.204	...
M	29.5871	29.5656	29.5616	29.5698	56.42	67.70	58.68	61.29	+ 0.26	.354	.409	.370	.377	.75	.59	.74	.69	....	....	....	....	4.40	8.58	3.72	....	6.11	2.329	...

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR JUNE, 1861.

Highest Barometer........................ 29.810 at 8 a. m. on 1st } Monthly range =
Lowest Barometer .... 29.176 at 4 p. m. on 15th } 0.634 inches.

Self-registering Thermom.
- Maximum Temperature .... 87°8 on p.m. of 9th } Monthly range=
- Minimum Temperature .... 41°6 on a.m. of 14th } 46°2
- Mean maximum Temperature .... 70°36 } Mean daily range=
- Mean minimum Temperature .... 51°26 } 19°11
- Greatest daily range .... 29°5 from a. m. to p. m. of 10th.
- Least daily range.................. 3°2 from a. m. to p. m. of 4th.

Warmest day......... 11th... Mean temperature......... 72.40 } Difference = 21°30.
Coldest day............ 5th... Mean temperature......... 51°10 }

Maximum { Solar................................ 102°0 on p. m. of 22nd } Monthly range =
Radiation. { Terrestrial........................ 33°0 on a. m. of 14th } 69°0

Aurora observed on 2 nights, viz.: 12th and 13th.
Possible to see Aurora on 18 nights; impossible on 12 nights.
Raining on 13 days,—depth 2.329 inches; duration of fall 32.3 hours.
Mean of cloudiness = 0.45. Below average 0.08.
Most cloudy hour observed, 4 p. m., mean = 0.53; least cloudy hour observed, 6 a.m., mean, = 0.37.

Sums of the components of the Atmospheric Current, expressed in miles.

North.	South.	East.	West.
2080.19	797.85	852.23	1887.51

Resultant direction N. 39° W.; Resultant velocity 2.29 miles per hour.
Mean velocity........................... 6.11 miles per hour.
Maximum velocity .... 33.2 miles, from 11 a. m. to noon on 3rd.
Most windy day ....12th......... Mean velocity, 15.31 miles per hour. } Difference=
Least windy day......... 1st......... Mean velocity 1.35 ditto. } 13.96 miles.
Most windy hour......11 a.m. to noon.........Mean velocity 9.13 ditto. } Difference =
Least windy hour...midnight to 1 a.m......Mean velocity 3.52 ditto. } 5.61 miles.

2nd. Afternoon very foggy and gloomy.
3rd. Solar Halo at 5.30 p. m.
4th. Solar Halo at 7.30 and 8 a. m.
9th. Bright Meteor in S. E. at 8.45 p. m.
11th. Sheet Lightning in W. at 9.15 p. m.
13th. Brilliant Meteor in N. W. at 0.20 a. m.
15th. Thunderstorm, rain and hail, 8 a. m. to 5 p. m. Pollen of Plants fell in this day's rain.
19th. Thunderstorm, lightning and rain, 3.45 to 10 p. m.
24th. Solar Halo at noon. Fire Flies numerous at night.
30th. Thunderstorm from 1 to 7 p. m.

Heavy Dew recorded on 12 mornings during the month.

The Resultant Direction and Velocity of the Wind for the month of June, from 1848 to 1861 inclusive, were respectively N. 69 W. and 0.81 miles.

COMPARATIVE TABLE FOR JUNE.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	No. of days.	Inch's.	No. of days.	Inch's.	Resultant Direction.	Resultant V'y.	Mean Force or Velocity.
1840	° 59.8	° −1.6	° 78.5	° 37.1	° 41.4	11	4.860	...	...	...	...	....
1841	65.6	+4.2	92.8	45.7	47.1	9	1.560	...	...	...	...	0.36 lbs.
1842	55.6	−5.8	73.9	28.0	45.9	15	5.755	...	...	...	...	0.31
1843	58.4	−3.0	81.3	28.5	52.8	12	4.595	...	...	...	...	0.27
1844	59.9	−1.5	82.8	33.1	49.7	9	3.535	...	...	...	...	0.19
1845	61.0	−0.4	83.6	40.9	42.7	11	3.715	...	...	...	...	0.27
1846	63.3	+1.9	83.3	41.5	41.8	10	1.920	...	...	...	...	0.32
1847	58.4	−3.0	78.3	36.7	41.6	14	2.625	...	...	...	...	0.30
1848	62.9	+1.5	92.5	38.3	54.2	8	1.810	...	...	N 61° W	1.90	4.51 mls.
1849	63.2	+1.8	84.9	45.2	39.7	7	2.020	...	...	S 71° E	0.40	3.32
1850	64.3	+2.9	83.2	49.0	34.2	10	3.345	...	...	S 60° W	0.38	[illegible]
1851	59.2	−2.2	79.2	41.2	38.0	11	2.695	...	...	S 2° W	1.26	4.42
1852	60.8	−0.6	86.1	43.6	42.5	10	3.160	...	...	S 76° W	1.49	4.09
1853	65.5	+4.1	86.3	43.3	43.0	9	1.550	...	...	N 1° W	0.10	3.73
1854	64.1	+2.7	88.7	47.4	41.3	9	1.460	...	...	N 24° E	0.71	4.15
1855	59.9	−1.5	90.7	40.6	50.1	17	4.070	...	...	N 69° W	1.33	5.70
1856	62.1	+0.7	82.6	48.3	34.3	13	3.200	...	...	S 21° W	0.90	5.30
1857	56.9	−4.5	75.1	40.9	34.2	21	5.060	...	...	N 49° W	1.15	7.60
1858	66.2	+4.8	86.3	48.7	37.6	12	2.943	...	...	S 20° E	0.25	5.53
1859	58.3	−3.1	85.2	33.9	51.3	16	4.085	2	Inap.	N 77° W	1.95	7.19
1860	63.2	+1.8	81.1	50.0	31.1	14	2.136	...	...	N 44° W	3.13	7.61
1861	61.3	−0.1	86.5	48.2	38.3	13	2.329	...	...	N 39° W	2.29	6.11
M	61.36	...	83.77	41.37	42.40	11.9	3.100	...	...	....	...	5.27 Ml.
Diff. from av'g.	− 0.07	...	+ 2.73	+ 6.83	− 4.10	+ 1.1	− 0.771	...	...	....	...	+ 0.84

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—JULY, 1861.

Latitude—43 *deg.* 39.4 *min. North. Longitude*—5 *h.* 17 *m.* 33 *s. West. Elevation above Lake Ontario,* 108 *feet.*

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resul't. Direction.	Velocity of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10 PM	ME'N		6 A.M	2 P.M.	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A. M.	2 P. M.	10 P. M.		6 AM.	2 PM.	10 P.M.	Result'.	ME'N		
					°	°	°	°	°												°							
1	29.514	29.536	29.630	29.5622	59.8	63.7	55.4	59.23	— 5.53	.369	.353	.285	.337	.72	.60	.64	.67	N	N b W	N N W	N 21 W	3.8	9.0	12.0	6.17	6.33	...	...
2	.657	.665	.652	.6570	50.0	59.0	51.8	54.47	—10.53	.283	.280	.290	.277	.78	.56	.75	.66	N W b N	W b N	Calm.	N 44 W	9.0	5.8	0.0	9.16	9.25	. .	...
3	.691	.676	.710	.6903	59.4	77.1	61.6	66.90	+ 1.75	.286	.432	.393	.378	.56	.47	.71	.58	N W	S	Calm.	N 87 W	11.0	3.5	0.0	1.99	3.40	...	...
4	.738	.685	.641	.6820	60.9	76.0	63.4	67.53	+ 2.23	.378	.604	.404	.480	.70	.67	.69	.70	Calm.	S E	Calm.	S 1 E	0.0	7.0	0.0	2.08	2.37	...	...
5	.631	.571	.565	.5895	60.9	77.4	66.3	69.77	+ 4.38	.389	.585	.445	.477	.73	.62	.68	.65	Calm.	S S E	Calm.	S	0.0	9.2	0.0	3.00	3.32	...	...
6	.569	.572	.557	.5640	65.2	78.9	64.1	69.93	+ 4.33	.458	.535	.459	.500	.73	.54	.76	.69	Calm.	S	Calm.	S 9 W	0.0	8.2	0.0	1.89	1.90	...	...
7	.596	.547	—	—	65.5	80.3	—	—	—	.559	.657	—	—	.89	.63	—	—	Calm.	S	Calm.	S 18 W	0.0	8.6	0.0	2.11	2.17	Inp.	...
8	.522	.394	.378	.4273	71.7	78.2	70.2	73.85	+ 8.07	.603	.636	.666	.658	.78	.65	.91	.79	Calm.	S W b S	Calm.	S 24 W	0.0	10.0	0.0	4.76	4.91	0.035	...
9	.312	.314	.339	.3187	68.4	80.7	65.6	72.05	+ 6.07	.618	.702	.492	.596	.90	.66	.77	.75	S W b W	W N W	Calm.	N 81 W	1.5	7.0	0.0	4.86	5.29	Inp.	...
10	.357	.344	.395	.3707	60.9	71.5	60.1	64.38	— 1.70	.415	.493	.476	.458	.78	.64	.92	.77	Calm.	S E b S	N E b N	N 12 E	0.0	7.0	8.0	5.91	8.30	0.875	...
11	.388	.390	.473	.4207	53.6	59.0	53.3	55.27	—10.92	.351	.358	.323	.336	.85	.71	.79	.77	N N W	N W b N	N W	N 39 W	12.0	4.6	1.2	8.01	8.35	0.013	...
12	.520	.551	.679	.5890	52.2	62.7	55.1	57.98	— 8.32	.315	.379	.331	.352	.80	.66	.76	.73	W b N	S b W	N W b N	N 42 W	5.5	4.0	9.0	8.87	9.67	...	...
13	.733	.764	.830	.7790	56.9	65.9	56.9	59.92	— 6.47	.384	.398	.374	.390	.83	.62	.80	.76	N b W	S W b S	Calm.	N 19 W	5.2	1.5	0.0	0.45	1.94	...	...
14	.824	.771	—	—	58.7	70.2	—	—	—	.396	.417	—	—	.80	.57	—	—	N	S b E	Calm.	S 16 E	3.6	3.2	0.0	0.69	1.35	...	...
15	.614	.565	.476	.5453	58.7	63.0	59.0	59.75	— 6.73	.407	.450	.476	.441	.83	.78	.95	.86	Calm.	N b E	Calm.	N 38 W	0.0	2.0	0.0	0.63	0.90	0.135	...
16	.444	.393	.504	.4565	63.0	72.0	60.1	64.30	— 2.28	.526	.542	.266	.439	.91	.69	.51	.71	Calm.	S b W	N W	N 69 W	0.0	3.0	10.0	2.35	3.35	0.245	...
17	.588	.546	.558	.5630	52.9	67.7	59.8	61.88	— 4.80	.296	.452	.417	.409	.74	.67	.81	.73	Calm.	S E	Calm.	S 21 E	0.0	9.2	0.0	1.95	2.14	...	...
18	.570	.493	.458	.5058	58.0	72.4	69.1	67.28	+ 0.60	.416	.579	.553	.522	.86	.73	.77	.78	S W	S S W	W b N	S 28 W	0.5	12.8	2.6	3.90	4.58	0.007	...
19	.409	.361	.350	.3688	63.7	71.0	64.5	66.63	— 0.15	.491	.513	.560	.521	.83	.67	.92	.80	Calm	Calm.	N b W	N 19 W	0.0	0.0	3.0	1.58	3.60	0.400	...
20	.317	.381	.505	.4107	59.8	71.0	58.7	63.38	— 3.38	.428	.513	.361	.429	.83	.67	.73	.72	N W b W	N W	W N W	N 44 W	13.4	18.5	5.8	10.01	10.08	...	...
21	.565	.573	—	—	58.0	65.2	—	—	—	.370	.497	—	—	.77	.80	—	—	N W b N	S W b S	Calm.	N 40 W	3.0	1.0	0.0	3.65	4.50	0.010	...
22	.606	.622	.645	.6270	56.2	64.1	58.3	60.77	— 6.10	.371	.435	.344	.389	.82	.73	.71	.73	N	S S W	N N W	N 36 W	3.4	5.8	5.8	2.72	4.87	Inp.	...
23	.654	.647	.715	.6755	58.7	73.1	61.6	65.87	— 1.02	.345	.385	.381	.354	.69	.48	.69	.57	N N W	S b E	Calm.	N 1 E	7.0	5.5	0.0	4.03	4.79	...	...
24	.746	.723	.712	.7293	61.9	72.0	61.9	66.12	— 0.75	.413	.569	.489	.511	.75	.73	.88	.80	Calm.	S	E S E	S 31 E	0.0	4.5	0.8	1.65	1.88	...	...
25	.765	.683	.652	.6962	58.3	75.7	67.4	67.83	+ 0.87	.390	.541	.416	.453	.80	.61	.61	.67	Calm.	S E b S	S	S 7 E	0.0	11.3	3.6	3.92	4.15	...	...
26	.599	.546	.535	.5572	65.9	74.6	68.4	70.30	+ 3.33	.514	.550	.662	.577	.81	.63	.95	.78	Calm.	S b W	Calm.	S 17 W	0.0	6.5	0.0	3.66	4.12	0.085	...
27	.561	.572	.555	.5627	66.3	72.8	66.6	68.68	+ 1.70	.603	.574	.504	.558	.93	.71	.77	.80	N	E	E	N 83 E	0.6	8.0	3.5	4.39	4.57	...	...
28	.423	.269	—	—	66.6	73.1	—	—	—	.599	.658	—	—	.92	.81	—	—	E b N	S E b S	S W b S	S 13 E	4.0	15.0	9.0	7.19	9.35	0.590	...
29	.355	.428	.534	.4503	62.7	71.7	65.9	66.57	— 0.38	.504	.618	.540	.537	.88	.79	.85	.82	S S W	W S W	Calm	S 56 W	8.5	14.0	0.0	5.30	5.75	Inp.	...
30	.591	.561	.520	.5580	61.6	79.6	68.4	71.20	+ 4.25	.456	.605	.561	.558	.83	.60	.81	.73	Calm.	S	S W	S 15 W	0.0	6.5	2.2	3.30	3.82	0.230	...
31	.519	.468	.516	.5058	67.4	79.3	71.7	73.02	+ 6.07	.632	.704	.646	.663	.94	.69	.84	.82	S S W	N N E	N W b N	N 26 W	1.2	4.2	1.0	1.85	3.51	0.010	...
M	29.5541	29.5352	29.5590	29.5505	60.56	71.49	62.41	65.37	— 0.88	.431	.511	.440	.467	.80	.65	.78	.73	....	....	....	....	3.01	6.98	2.50	......	4.66	2.635	......

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR JULY, 1861.

Highest Barometer	29.830 at 10 p. m. on 13th.	Monthly range= 0.561 inches.
Lowest Barometer	29.269 at 2 p. m. on 28th.	
Self-registering Ther. — Maximum temperature	84°5 on p.m. of 7th	Monthly range= 37°5
Minimum temperature	47°0 on a.m. of 2nd	
Mean maximum temperature . .	74°67	Mean daily range=18°44.
Mean minimum temperature . .	56°23	
Greatest daily range	29°1 from a. m. to p. m. on 3rd.	
Least daily range	8.0 from a. m. to p. m. on 11th.	
Warmest day . . 8th ...	Mean Temperature . . .=73°85	Difference=19°38.
Coldest day . . . 2nd ...	Mean Temperature . . .=54°47	
Maximum Radiation — Solar	99°8 on p. m of 9th	Monthly range= 62°8.
Terrestrial	37°0 on a. m. of 17th	

Aurora observed on 1 night, viz: on 9th; possible to see Aurora on 17 nights; impossible on 14 nights.

Snowing on — day: depth, — inches; duration of fall, — hours.

Raining on 16 days; depth, 2·635 inches; duration of fall, 34.7 hours.

Mean of cloudiness=0.56, above average 0.11; most cloudy hour observed 4 p. m., mean =0.67; least cloudy hour observed mid., mean=0.42.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
1482.96	1190.32	383.47	1410.04

Resultant direction, N 74° W; Resultant Velocity, 1.43 miles per hour.

Mean velocity 4.66 miles per hour.

Maximum velocity . . . 20.0 miles, from 3 to 4 p.m. on the 20th.

Most windy day . . 20th—Mean velocity 10.08 miles per hour. } Difference
Least windy day . . 15th—Mean velocity, 0.90 do } 9.18 miles.

Most windy hour, 4 to 5 p. m.—Mean velocity, 8.07 miles per hour. } Difference
Least windy hour, 11 p. m to mid.—Mean velocity, 2.34 do. } 5.73 miles.

1st. Distant thunder at 8 p. m.—4th. Fireflies very numerous at night.—8th. Thunderstorm, lightning and rain from 3.40 p. m.—10th. Thunderstorm from 3.40 p.m. Heavy rain from 4 p. m., continuing all night.—15th. Thunderstorm, lightning and rain from 9 to 11.40 p. m.—16th. Thunderstorm, vivid lightning, and heavy rain from 2.10 to 2.50 p. m.—18th. Thunderstorm, lightning, and slight rain, 2 p. m. to midnight.—19th. Thunderstorm from 2 p. m. to 10.15 p. m.—26th. Indistinct solar halo at 6 a. m.—28th. Thunderstorm, with very heavy rain, 8.30 a.m. to 0.30 p. m.—30th. Severe thunderstorm from 10 p. m. to 2 a. m. of 31st.—31st. Sheet lightning in S.E. at 10 p. m. Shooting stars numerous at night.

Heavy dew recorded on 10 mornings during the month.

The Resultant Direction and Velocity of the Wind for the month of July, from 1848 to 1861 inclusive, were respectively N. 65° W., and 0.49 miles.

COMPARATIVE TABLE FOR JULY.

YEAR.	TEMPERATURE. Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	RAIN. No. of days.	Inches.	SNOW. No. of days.	Inches.	WIND. Resultant Direction.	Resultant Velocity.	Mean Velocity
1840	65.8°	— 1.0	79.4°	48.2°	31.2°	6	5.270	...	...	...°	...	...
1841	65.0	— 1.8	86.3	43.2	43.1	10	8.150	...	...	...	...	0.27lbs
1842	64.7	— 2.1	90.5	42.0	48.5	4	3.050	...	...	...	...	0.33 "
1843	64.5	— 2.3	86.1	40.2	45.9	8	4.605	...	...	...	...	0.44 "
1844	66.0	— 0.8	86.1	40.5	45.6	12	2.815	...	...	...	...	0.19 "
1845	66.2	— 0.6	94.6	45.6	49.0	7	2.195	...	...	...	...	0.30 "
1846	68.0	+ 1.2	94.0	44.9	49.1	9	2.895	...	...	...	...	0.29 "
1847	68.0	+ 1.2	87.5	43.8	43.7	8	3.355	...	...	...	...	0.19 "
1848	65.5	— 1.3	82.7	46.7	36.0	10	1.890	...	...	N 14 W	0.18	4.94ms.
1849	68.4	+ 1.6	89.1	51.0	38.1	4	3.415	...	...	S 5 W	0.75	3.52 "
1850	68.9	+ 2.1	84.9	52.8	32.1	12	5.270	...	...	N 81 E	0.59	4.56 "
1851	65.0	— 1.8	82.7	52.1	30.6	12	3.625	...	...	N 60 W	0.88	4.13 "
1852	66 8	— 0.0	90.1	49.5	40.6	8	4.025	...	...	N 43 W	0.93	3.33 "
1853	65.6	— 1.2	85.4	49.4	36.0	10	0.915	...	...	S 58 E	-0.24	3.69 "
1854	72.5	+ 5.7	93.6	53.0	40.6	9	4.805	...	...	S 49 W	0.37	4.03 "
1855	67.9	+ 1.1	88.4	53.1	35.3	13	3.245	...	...	S 19 W	0.73	6.47 "
1856	69.9	+ 3.1	92 0	51.4	40.6	8	1.120	...	...	N 79 W	1.57	5.84 "
1857	67.8	+ 1.0	85.4	52.4	33.0	15	3.475	...	...	S 68 E	0.81	4.74 "
1858	67.9	+ 1.1	83.4	55.9	27.5	13	3 072	...	...	N 15 E	1.13	5.76 "
1859	66.9	+ 0.1	87 7	50.5	37.2	12	2.611	...	...	N 56 W	1.48	5.81 "
1860	63.9	— 2.9	85.8	47.5	38.3	13	4.336	...	...	N 60 W	2.15	7.29 "
1861	65.4	— 1.4	82.9	49.4	33.5	16	2.635	...	...	N 74 W	1.43	4.66 "
Mean	66.85	...	87.21	48.32	38.89	10.0	3.490	...	...	...	...	4 91
Diff. from Av'ge.	—1.48	...	—4.31	+ 1.08	—5.39	+ 6.0	—.855	...	...	...	...	—0.25

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—JUNE, 1861.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.—F.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Horizontal Movement in Miles in 24 hours.	Mean of Ozone. (tenths)	Rain in Inches.	Snow in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.					6 A.M.	2 P.M.	10 P.M.
1	30.042	29.995	29.905	54.6	79.9	65.6	.335	.567	.413	.80	.37	.66	s w	s w	s w	88.44	3.0	...	...	Clear.	Cum. 2 S. Ha.	Cirr. 2. L. H.
2	032	938	800	55.7	81.2	67.0	.349	.547	.450	.81	.52	.67	N E b E	N E b E	s E	139.50	3.0	...	...	Cirr. Str. 4.	Lt. Cir. 2S. H.	Cirr. Str. 2.
3	29.474	311	564	60.1	77.0	63.7	.449	.685	.510	.85	.75	.88	s s E	w s w	w N w	333.70	3.5	2.333	...	Rain.	C. C. Str. 8.	Do. 3.
4	850	717	921	49.0	65.8	53.8	.278	.436	.367	.81	.80	.88	N N w	w s w	N	218.70	2.0	...	...	Clear.	Light Cirr. 4.	Clear.
5	30.117	30.063	30.126	48.4	72.3	59.0	.260	.340	.387	.78	.45	.79	s s E	s E b E	s E b E	85.30	2.0	...	...	Do.	Clear.	Cirr. Str. 6.
6	041	29.993	29.937	52.3	67.7	57.6	.334	.418	.343	.86	.62	.72	s s E	s E	s E	169.30	2.0	...	...	C. C. Str. 10.	C. C. Str. 8.	C. C. Str. 8.
7	29.904	870	800	59.6	72.8	70.6	.433	.450	.586	.85	.48	.80	E s E	s b E	s s E	28.00	2.5	0.100	...	Cu. Str. 8.	Cirr. 4.	Clear.
8	862	772	898	58.7	80.4	63.0	.452	.567	.485	.94	.57	.86	s E	s b E	s b w	5.70	2.0	...	...	Clear.	Clear.	Cu. Str. 8.
9	768	785	892	67.0	89.8	74.9	.556	.990	.673	.84	.71	.79	s s E	s w	s w	54.90	2.0	...	...	Do.	Do.	Str. 4.
10	843	770	630	70.9	95.8	76.7	.621	.949	.614	.85	.78	.68	s b w	s b w	s s w	35.70	2.0	...	...	Do.	Do.	Clear.
11	625	472	462	70.1	94.9	75.5	.516	.814	.597	.70	.54	.71	s w	s s w	sw b w	10.20	1.5	...	...	Do.	Do.	Cirr. 4.
12	435	472	632	69.5	79.2	60.8	.628	.581	333	.88	.60	.63	w s w	w s w	N b w	211.10	2.5	...	...	Cu. Str. 10.	Cu. Str. 4.	Clear.
13	788	755	790	56.2	63.0	51.0	.342	.229	.270	.78	.41	.72	w	w	w	253.50	3.0	In'p.	...	Nim. 10.	Do. 4.	Cu. Str. 4.
14	822	755	750	58.0	68.5	54.0	.337	.343	.341	.70	.49	.83	w s w	w s w	s w b s	306.80	2.5	...	...	Clear.	C. C. Str. 6.	Nim. 10.
15	500	363	434	56.1	64.2	58.1	.420	.464	.452	.94	.77	.94	E s E	N E b E	s w	72.40	4.0	0.989	...	Rain.	Rain.	Cu. Str. 8. L'g.
16	477	567	790	56.6	73.0	52.0	.391	.383	.264	.87	.48	.69	N N E	N N E	N b E	264.90	2.5	0.700	...	Nim. 10.	Clear.	Clear.
17	833	866	842	58.1	69.5	56.5	.255	.437	.357	.53	.63	.78	s E b E	s E	s s w	118.00	1.5	...	...	Clear.	Do.	Do.
18	791	814	869	50.2	64.7	57.6	.328	.427	.372	.89	.71	.78	s w	s w	s w	162.00	1.0	...	...	Do.	Do.	Do.
19	689	576	697	60.4	80.9	63.2	.433	.599	.510	.85	.50	.88	s b w	s s w	w s w	157.80	2.5	0.236	...	C. C. Str. 10.	C. C. Str. 4.	C. C. Str. 4. D.
20	662	747	811	58.4	64.1	58.3	.372	.433	.394	.78	.73	.82	w b N	w s w	w s w	230.39	2.5	...	...	Nim. 10.	Do. 8.	Cllear. [Thu.
21	675	546	562	60.9	61.2	59.1	.419	.442	.439	80	.83	.88	s s w	s s E	s E b E	26.20	2.5	In'p.	...	Heavy dew.	Cirr. 10.	Cu. Str. 10.
22	574	564	555	59.3	62.4	69.0	.462	.399	.564	.91	.72	.79	w b s	w b s	s s w	222.50	2.0	...	...	C. C. Str. 9.	Cu. Str. 4.	Do. 8.
23	420	428	640	67.6	67.2	51.0	.591	.556	.302	.89	.84	.82	w s w	w b s	w b s	393.70	3.0	0.010	...	Do. 4.	Do. 8.	Do. 8.
24	616	735	850	43.2	69.6	57.0	.209	.336	.302	.75	.47	.66	w b N	w b N	w N w	200.60	2.5	...	...	Clear.	Cirr. 2.	Clear.
25	842	772	700	55.0	87.9	68.7	.328	.921	.571	.77	.71	.82	s w b w	s s w	s s w	66.30	2.0	...	...	Cu. Str. 8.	Clear.	Do.
26	583	584	614	68.4	77.0	65.9	.612	.685	.444	.90	.75	.71	s s w	w	w	275.10	3.5	0.200	...	Do. 8.	Cu. Str. 9.	Cu. Str. 8.
27	720	715	751	64.2	73.6	64.3	.471	.504	.464	.81	.61	.77	w b N	w b N	w b N	156.70	3.0	...	...	Clear.	Clear.	Do. 4.
28	660	565	732	61.2	69.7	66.0	.383	.490	.509	.71	.68	.81	w s w	s	w s w	218.70	2.0	0.300	...	Do.	Nim. 9.	Clear.
29	733	704	706	60.1	78.2	62.4	.376	.450	.422	.73	.67	.75	s w b s	w s w	w s w	177.80	2.0	...	...	Do.	Cirr. 4.	Do. Au. Bor.
30	568	684	661	64.6	78.7	61.0	.444	.588	.419	.75	.62	.80	w b s	w s w	s E	177.10	1.0	...	...	C. C. Str. 8.	Cu. Str. 10.	Cu. Str. 8.
...		...	...	...	...	...	...	...	...	...			...	...	...	...	...	...	...	...	...	Com. first seen

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—JULY, 1861.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M.D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.—F.			Tension of Vapour.			Humidity of Air.			Direction of Wind.			Horizontal Movement in Miles in 24 hours.	Mean of Ozone. t'nths	Rain in inches	Snow in inches.	WEATHER, &c. A Cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A. M.	2 P. M.	10 P. M.	6 A. M.	2 P. M.	10 P. M.	6 A. M.	2 P. M.	10 P. M.	6 A. M.	2 P. M.	10 P. M.	6 A. M.	2 P. M.	10 P. M.					6 A. M.	2 P. M.	10 P. M.
1	29.701	29.742	29.765	56.6	71.4	59.4	.385	.509	.358	.84	.68	.73	S S E	S S E	N E b E	439 20	2.0	0.170	...	Cu. Str. 10.	C. C. Str. 4.	Cirr. Str. 8.
2	701	670	675	54.5	58.3	56.9	383	394	429	90	82	91	N E b E	N N E	N E b E	495.00	3.0	3.210	...	Rain.	Rain.	Rain.
3	720	842	831	61.0	76.0	65.0	449	652	516	85	73	84	N N E	S S W	S S E	218.22	2.0	0.300	...	Cu. St. 10.	Cu. Str. 10.	Clear. Comet
4	862	875	895	61.0	85.1	66.3	433	577	470	85	49	73	S W	S S W	S S W	211.60	1.0	...	...	Clear.	Clear.	Do. [visible.
5	840	770	794	71.8	91.0	72.0	566	894	601	74	64	78	S S W	S S W	S	92.60	1.0	...	...	Do.	Do.	Do.
6	781	713	800	70.0	93.5	75.0	557	793	507	77	50	71	S	S S E	S b W	77.80	1.0	...	...	Do.	Do.	Do.
7	888	775	722	72.4	89.6	77.0	681	798	765	81	63	84	S b W	S W	S W	121.10	1.5	...	...	Cirr. Cum. 6.	C. C. Str. 4.	Rain.
8	683	783	550	74.0	89.7	66.5	686	714	529	83	52	82	S S W	S S W	S E	177.00	2.0	...	...	C. C. Str. 6.	Cirr. 4.	Nim. 10.
9	475	511	400	70.2	81.0	67.7	557	717	584	77	70	87	S S W	S S W	W N W	70.84	2.0	1.310	...	Cu. Str. 8.	C. C. Str. 4.	Cu. Str. 4.
10	470	574	702	67.0	76.0	65.1	529	652	549	82	73	80	E S E	N E	N N E	84.00	1.0	...	...	C. C. Str. 4.	Clear.	Clear.
11	590	528	577	51.3	57.4	57.0	341	400	385	89	84	84	N E b E	N E b E	E b S	427.50	2.5	0.863	...	Rain.	Cu. Str. 4.	Do. Au. Bor.
12	633	599	781	54.1	62.1	55.2	362	376	376	87	69	87	S S W	S W	W b S	208.60	2.5	...	...	C. Cum. 4.	Do. 8.	Str. 2. do.
13	882	976	987	58.5	77.6	58.0	429	457	423	91	49	88	S W	S W	N E b E	55.40	3.0	0.074	...	Do. 4.	Do. 8.	Clear. do.
14	30.037	869	902	56.4	72.4	60.1	385	483	456	84	61	88	N E b E	E S E	E S E	58.30	2.0	...	...	C. C. Str. 6.	C. C. Str. 4.	C. C. Str. 4.
15	29.776	709	714	56.1	62.3	60.0	420	523	469	94	94	94	N E b E	S W b S	S W b S	94.20	2.5	0.696	...	Rain.	Rain.	Rain.
16	656	603	666	63.2	69.9	60.3	510	577	456	88	85	88	S	S S W	S b W	166.10	2.5	0.603	...	C. C. Str. 10.	Do.	Cu. Str. 4.
17	688	705	854	53.2	73.2	59.0	321	416	416	80	52	85	W S W	S W	S S W	150.60	1.0	...	...	Clear.	C. C. Str. 4.	Clear. [light.
18	752	713	688	61.1	83.3	70.4	390	505	516	74	51	90	S S W	S S W	E S E	99.90	1.0	...	...	Cirr. Str. 2.	Do. 4.	Cirr. 10. dist.
19	696	582	568	64.0	70.4	65.2	497	530	542	83	69	87	W S W	W S W	N E b E	79.30	1.5	1.126	...	Cu. Str, 10.	Do. 4.	Cu. Str. 10.
20	420	405	470	63.0	74.1	60.0	503	442	456	86	55	88	E	N W	W b S	67.10	2.0	0.576	...	Rain.	Cu. St. 9.	Do. 4.
21	575	588	632	60 1	72.6	58.5	426	483	387	82	61	79	W b N	W b N	W b N	364.00	2.0	0.131	...	Do.	Do. 4.	Clear.
22	600	612	760	60.0	66.0	57.0	345	353	385	68	56	84	S W	W	W	230.40	1.0	...	...	Clear.	C. C. Str. 8.	Cu. Str. 4.
23	762	782	853	60.0	72.1	61.5	433	455	466	85	56	85	E b N	N N E	W S W	75.00	1.0	...	...	Cu. Str. 4.	Cu. Str. 10.	C. C. Str. 10.
24	921	869	976	56.7	77.2	61.7	385	534	436	84	59	80	W S W	S W b W	S S E	6.20	1.0	...	...	C. C. Str. 10.	C. C. Str. 4.	Clear.
25	930	942	980	57.6	74.2	65.8	349	436	509	74	53	81	S	S S E	S S E	0.70	1.5	...	...	Clear.	Cu. Str. 4.	Do. Au. Bor.
26	904	904	875	66.1	84.1	69.1	542	590	536	87	51	77	S b E	S S E	S S E	0.50	1.5	...	...	Do.	Clear.	Cu. Str. 2.
27	835	832	838	71.9	78.0	71.0	537	671	688	71	71	92	S S E	N W	E S E	53.60	2.5	0.200	...	Cu. Str. 10.	C. C. Str. 6.	Rain.
28	891	735	712	69.0	85.0	71.3	571	691	615	82	57	83	S S E	S S E	S S E	50.80	1.0	...	...	Clear.	Do. 4.	C. C. Str. 2.
29	688	760	833	69.0	79.0	69.4	642	907	380	92	93	56	S	S S E	S S E	204.70	2.0	0.163	...	Rain.	Cu Str. 6.	Cu. Str. 4.
30	748	722	755	70.4	88.9	69.0	621	908	536	85	68	77	S S W	S S W	S	87.20	1.0	...	...	C. C. Str. 8.	C. C. Str. 4.	Clear.
31	844	800	736	67.6	79.7	68.2	584	724	584	87	72	87	S b E	S b W	S S E	76.40	1.5	0.766	...	Rain.	Do. 8.	Str. 4.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR JUNE.

Barometer	**Highest, the 5th day**	**30.126**
	Lowest, the 3rd day	**29-311**
	Monthly Mean	**29.720**
	Monthly Range	**0.815**
Thermometer	**Highest, the 9th day**	**99°.7**
	Lowest, the 17th day	**40°.1**
	Monthly Mean	**65°.83**
	Monthly Range	**59°.6**
Greatest Intensity of the Sun's Rays		**104°.3**
Lowest Point of Terrestrial Radiation		**36°.4**
Amount of evaporation		**3.73**
Mean of Humidity		**.735**

Rain fell on 10 days, amounting to 4.868 inches; it was raining 56 hours and 18 minutes, and was accompanied by thunder on 3 days.

Most prevalent wind, the W. S. W.

Least prevalent wind, the N.

Most windy day, the 23rd; mean miles per hour, 12.23.

Least windy day, the 8th; mean miles per hour, 0.23.

Solar Haloes visible on 2 days.

Lunar Halo visible on 1 night.

Aurora Borealis visible on 1 night.

The Electrical state of the Atmosphere has indicated moderate intensity.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR JULY, 1861.

Barometer	**Highest, the 14th day**	**30.037**
	Lowest, the 9th day	**29 400**
	Monthly Mean	**29.734**
	Monthly Range	**0.637**
Thermometer	**Highest, the 6th day**	**90°2**
	Lowest, the 23rd day	**47°4**
	Monthly Mean	**67°66**
	Monthly Range	**51°8**
Greatest intensity of the Sun's rays		**104°1**
Lowest point of Terrestrial Radiation		**47°0**
Mean of Humidity		**.765**
Amount of Evaporation		**2.72**

Rain fell on 14 days, amounting to 10.188 inches; it was raining 79 hours and 49 minutes, and was accompanied by thunder on 4 days.

Most prevalent wind, S. E. byE.

Least prevalent wind, E.

Most windy day, the 2nd day; mean miles per hour, 20.60.

Least windy day, the 26th day : mean miles per hour 0.02.

Aurora Borealis visible on 4 nights.

Comet visible.

Earthquake felt here at 9.03 p. m. 11th day.

Tornado in Montreal 9th day.

The Electrical state of the Atmosphere has indicated moderate intensity.

consisting of carpels only.*

THE CANADIAN JOURNAL.

NEW SERIES.

No. XXXVI.—NOVEMBER, 1861.

AN ATTEMPT AT AN IMPROVED CLASSIFICATION OF FRUITS.

BY WILLIAM HINCKS, F.L.S., ETC.,
PROFESSOR OF NATURAL HISTORY, UNIVERSITY COLLEGE, TORONTO.

Read before the Canadian Institute, April 6th, 1861.

In the course of my botanical labours, both as a teacher and a student of scientific characters, I have strongly felt the importance of great accuracy in the definition of the different kinds of fruits,—in reference not to mere external marks, but to their real nature and structural constitution. My acquaintance with a very great number of botanical treatises, has not yet introduced me to any arrangement entirely satisfactory to my mind; I have, therefore, made an attempt to supply the deficiency, which I lay before the Institute as a slight contribution to practical science, which can be best appreciated by those most immediately engaged in this class of studies.

I premise that the gynœcium, the germ-producing part of the flower—like the andrœceum, the corolla, and the calyx—consists of one or more circles of similar organs, each of which is in its essential nature a leaf modified in its development, as is abundantly proved by analogical reasoning and by monstrosities. In the case of the gynœcium, each distinct organ is called a carpel (carpellum), its tip being the stigma; its elongated extremity, when present, the style; and the germs being produced in some definite relation to it, most usually

along its border. Although the production of germs from the axis, as maintained by some high botanical authorities, is not antecedently very improbable, I cannot consider it as established by any good evidence, and it supposes so remarkable an anomaly in the mode of fertilization, as cannot be admitted without certain proof. Again, each carpel, according to the analogy of the leaf, has an upper and under surface, and a middle portion containing the vascular system. The under surface, which forms the external covering of the fruit, is called the epicarp; the vascular layer, the mesocarp; and the upper surface, which lines the interior of the carpel, the endocarp. The differences in the mode of development of these parts, explain the membranous, coriaceous, woody, fleshy, or pulpy character of fruits, or certain portions of them; and it thus appears why these differences are of minor importance, and may occur between fruits of the same essential structure.

The number of germs produced in a carpel depends partly on the productive tendency inherent in the species, arising from its elemental structure and vital energy; much, also, on the space afforded to it and the amount of nutriment it receives. It is common for a carpel to be single-seeded, and not uncommon for the seed so closely to fill the folded carpel that the whole passes for a naked seed. It may have two or several seeds; and in a few instances the germ-producing or placental portion of the edge of the carpel is extended and crowded with germs so as greatly to multiply the seeds. The coherence of carpels in a circle is very common, and may either be slight and partial, producing a lobed fruit, or more complete—either by the edges only of the carpels, causing a one-celled capsule with parietal placentæ, by their meeting on the axis so as to cause axillary placentæ, or by their turning inward from the axis, so that the placentæ project into the cells; and in these cases, if the substance be membranous, coriaceous, or woody, the opening may be by the separation of the carpels, by the splitting asunder of the midrib of the carpel, by separation of the external portion from the firmly united infolded parts, by the turning back of valves at the upper part, by circumscission, or by pores formed to allow of the escape of the seeds. If we add to these circumstances the various adherences of exterior parts, we have the means of explaining the nature of all known fruits. We endeavour to express the facts with as many distinct names for varieties of fruits as we have found adopted by good authorities, and can perceive to be

useful, in the accompanying tabular view, which is by no means proposed as exhausting the varieties of fruits, but will at least sufficiently explain the principles upon which, I conceive, they ought to be studied.

ADDITIONAL NOTE ON THE OCCURRENCE OF FRESH WATER SHELLS IN THE UPPER DRIFT DEPOSITS OF WESTERN CANADA.

BY E. J. CHAPMAN,
PROFESSOR OF MINERALOGY AND GEOLOGY IN UNIVERSITY COLLEGE, TORONTO.

In a recent number of this Journal, I published a series of Notes on the general conditions of occurrence of the Drift deposits of Upper Canada, in which I strove to establish, more especially, the former extension and union of our great lake-waters. Amongst other facts tending to this view, I cited examples of the occurrence of fresh-water shells, identical with those of our existing lake-species, in some of the higher Drift-beds, as discovered respectively by Mr. Robert Bell of the Geological Survey of Canada, by Dr. Benjamin Workman, of Toronto, and by myself. I have now to add to the localities there cited, one of still higher interest in its bearings on this question, as it discloses, over a considerable area, an extraordinary abundance of fresh-water shells belonging to seven distinct genera. This locality was discovered and made known to me by one of my former students, Mr. A. E. Williamson, at present engaged on the Northern Railway of Canada. It lies around the Nottawasaga river, in the vicinity of the Angus Station of that railway. The shells, at least, are more abundant or best seen at this spot, but I have traced them over a distance of four miles south of Angus Station, and I have also found them to extend a mile or more in other directions. In all probability, however, they will be met with much beyond these limits, as my visit to the spot was a hurried one, and made during a day of extreme heat. They lie in fine sand, at various depths below the surface of the ground, varying, at the points examined, from about a foot to sixteen or eighteen feet, according to the surface inequalities of the district. Those at present collected comprise species of the following genera: *Unio, Cyclas, Amnicola, Valvata, Planorbis, Limnea,* and *Physa.* The

sand in which they occur is in some places obliquely stratified, and is underlaid (apparently everywhere) by a deposit of fine sharp gravel, also in places obliquely laminated. The unios, though very fragile, are of large size and well preserved; and so abundant are they, that a cart-load might be collected from some cuttings in less than an hour.

The following species of these shells have been collected altogether: *Unio complanatus*, with apparently another species, not at present determinable; *Cyclas similis*, *C. dubia*; *Amnicola porata*; *Valvata tricarinata*, *V. piscinalis*; *Planorbis trivolvis*, *P. campanulatus*, *P. bicarinatus (?)*; *Limnea palustris*; *Physa ancillaria*.

Around Angus Station there is a general depression of the country, but the Nottawasaga river at that spot is still about 30 feet above Georgian Bay, this latter lying at a distance of 22 or 23 miles to the north of it. The general level at which the shells occur at this locality may be taken at from 30 to 40 feet above Lake Huron, and at about 90 feet below the surface level of Lake Simcoe. The waters of this latter lake probably passed at one period from Kempenfeldt Bay into the Nottawasaga valley, and so escaped into Lake Huron by a more western channel than their present outlet at the Severn.

August 4th, 1861.

ON THE OCCURRENCE OF VANESSA CÆNIA IN CANADA WEST.

BY W. SAUNDERS, ESQ.

In May last, while on a visit to Port Stanley, I was much pleased to find in the possession of a collector there, Mr. William Edwards, two fine specimens of Vanessa Cænia which he had captured in the vicinity of the Port during the summer of 1858. No further captures of this beautiful insect were made until the present season, when, on the 30th of July, I received a note from my friend, stating that he had taken several specimens a day or two previous. On the 2nd of August I paid a visit to the spot where they occurred—which is on the railway track, about a mile from the Port. I had not been there

long before one of these handsome creatures came floating past me on the wing. An exciting chase ensued. Although its flights were short, it was very difficult to approach, and always when alighting, turned to face its pursuer. After many cautious, though ineffectual attempts to take it by bringing the net suddenly down on it, it was finally made prisoner by a sudden sweep. In a short time another was seen which was taken in the same way; and in about an hour afterwards a third made its appearance, but although I did my best to capture this, I could not succeed in taking it.

They are confined, as far as I could learn, to a spot on the railway track about two or three hundred yards in length. It was there the two specimens were taken in 1858, and there they occurred again this season; nevertheless, we searched diligently for many hours in the vicinity, but failed to find one in any other place.

It is very probable that this species may occur in other localities throughout the Province, since T. Cottle, Esq., of Woodstock, is of opinion that he has seen it on the wing near his residence. It would be well for collectors to keep a sharp look out on all suspicious-looking *Vanessæ*, as the occurrence of this species (which is, I believe, not generally supposed to be found far north of Virginia) in different localities throughout the Upper Province would be an exceedingly interesting fact in the annals of Entomology.

For the benefit of those who may not have seen this insect or its photograph, I have added a short description of it, in order that it may be readily recognized.

General color of upper surface brown; anterior wings having a broad whitish band extending nearly from the costal to the inner margin, and enclosing near the anal angle a large black, eyelike spot, encircled by a yellowish brown iris. In some specimens, a second and very small spot is situated near the tip exterior to the band. Two smaller reddish bands bordered with black, and placed at equal distances from the body and the white band, cross the discoidal cell.

On each of the posterior wings are two conspicuous eye-spots, the under one much smaller than the upper, both encircled by a yellow iris bordered with black. Between these eye-spots and the hind margin is placed a band of red bordered externally by one or more dark marginal lines. The under surface of the wings is much paler then that of the upper, and although the markings are similar they are much less distinct.

The Caterpillar is stated by Boisduval to feed on the Linaria Canadensis. It is black and spinous, with two lateral white lines, the upper of which is marked with a row of reddish spots.*

London, C. W., August 13, 1861.

A POPULAR EXPOSITION OF THE MINERALS AND GEOLOGY OF CANADA.

(Continued from page 455.)

BY E. J. CHAPMAN,
PROFESSOR OF MINERALOGY AND GEOLOGY IN UNIVERSITY COLLEGE, TORONTO.

PART IV.

SOME REMARKS ON ORGANIC REMAINS, WITH SPECIAL REFERENCE TO CANADIAN FORMS.

Many stratified rocks, it has already been explained, contain the fossilized remains or impressions of vegetable and animal forms—vestiges of departed races of plants and animals which peopled the Earth and its waters during the epochs in which these rocks were under process of deposition. So numerous in some instances are the remains in question, that certain strata appear to be almost entirely made up of them, either in a perfect or in a fragmentary condition. The study of these fossils has a three-fold value: first, in enabling us to recognise one rock division from another, each division holding its own proper and separate forms; secondly, in elucidating obscure points in the structural and other relations of existing types; and thirdly, in shedding light upon many of the past conditions of the globe, both physical and organic. In illustration of the first of more practically useful character in connexion with these remains, it may be observed that in the great coal-bearing and all overlying

* Since writing the above, Vanessa Cænia has been found in the townships of Ellis and Logan, about ten miles north of Stratford. From this it appears that its range is a more extensive one than I anticipated. The two places in which it has been found being some sixty miles or more apart, it is very probable that it will be met with in some spots intermediate. Since this Butterfly has undoubtedly been more prevalent than usual during the past season, it would be interesting to know to what extent it has prevailed in this section of country. I should be glad if collectors would communicate anything they know on the subject.—W. S.

strata, we do not meet with a single trace of the peculiar group of Crustaceans termed *Trilobites* (see figures and description in our next Number), although in earlier-formed or lower strata these forms occur generally, and often in great abundance. Hence, in a rock containing trilobites, no matter how similar such rock may be in aspect and mineral characters to coal-strata, we may be assured that it will be useless to bore or excavate for coal, at least with the expectation of finding great workable beds of that material, such as occur in the proper coal formation.

Some fossil remains, belonging to the most recent geological deposits, are identical with existing species; others are akin to these, without being actually identical with them; and others, again, are wholly without representatives in existing Nature. These various bodies comprise chiefly: the casts or impressious of sea-weeds, fern-fronds, and leaves of higher vegetable types, with occasional fruits and stems of trees; the remains of corals, star-fishes, and other radiated animals; the shells of mollusca; tests of crustaceans; and teeth, bones, and more or less complete skeletons of vertebrated animals. In some cases, these remains have evidently been entombed where the plants, corals, mollusks, &c., were actually living; whilst in others, they have been drifted to a greater or less distance with the sediments of which they now form part. The process of fossilization is a gradual replacement, atom by atom (as in the case of many mineral pseudomorphs), of the original organic substance of the body by mineral matter. The fossilizing agents comprise the general substance of the enclosing sediments, together with certain special substances, of which the more common include—silica, carbonate of lime, and carbonate of iron, the latter being frequently converted into peroxide of iron, and also into iron-pyrites. (See Vol. V., page 171.)

The causes which principally influence the preservation of organic bodies in the fossil slate, comprise:

1. The habitat of the plant or animal.

2. The conditions prevailing at the spot to which its remains may be brought, or at which it meets its death.

3. The inherent power of these remains to resist mechanical disintegration.

4. Their powers of resistance to chemical decomposition.

5. The nature of the rock-matters in which they may be enclosed; and the after conditions to which these matters may be subjected.

With regard to the first condition, it is abundantly evident that aquatic types are far more favourably circumstanced for preservation, than purely terrestrial forms; and littoral species, again, more so than pelagic tribes. But, allowing the body of the dead fish or floating cephalopod to be cast, uninjured, by winds and currents, on the shore, or the drowned mammal swept down to the river estuary, the co-operation of various conditions is required to ensure its preservation. Briefly—there may be no sediments under process of distribution at the spot; or the sediments may not be thrown down with sufficient rapidity to arrest decomposition; or the shore may be rocky and exposed, and mechanical destruction follow. Finally, if entombed forthwith, its calcareous parts may be dissolved out to constitute a cementing material for the surrounding mass; or subsequent metamorphic agencies may obliterate all traces of its form.

The more an organised substance approaches inorganic matter in its composition, the greater, of course, will be its capability of resisting the usual process of decay.

The following Table (drawn up chiefly from the researches of M. Hugard) shews, approximatively, the amount of inorganic matter in various animal bodies, and is thus of interest in a palæontological point of view:

Inorganic matter, 99 *or more*, *per cent.*:—Shells of Ostreæ and of some other acephalous mollusks.

Inorganic matter, 95 *to* 98 *per cent.*:—Most coral structures; shells of ordinary bivalves and gasteropods.

Inorganic matter, 90 *to* 95 *per cent.*:—Shells of ordinary cephalopods.

Inorganic matter, 60 *to* 70 *per cent.*:—Teeth of mammals, reptiles, and many fishes.

Inorganic matter, 50 *to* 66 *per cent.*:—Bones of mammals, birds, and reptiles; scales of fishes; shells of crustaceans.

Inorganic matter, 40 *to* 50 *per cent.*:—Elytra of certain insects (?).

Inorganic matter, *under* 5 *or* 6 *per cent.*:—Scales of reptiles; cartilage, hair, horns, and nails of mammals; feathers of birds, &c.

Fossilized Vegetable Remains:*—The fossil plants obtained from

* It will of course be understood that we are not attempting, here, an Essay on Palæontology. Our object is chiefly to convey to the uninitiated reader such an amount of information as will enable him to understand the terms of general employment in palæontological descriptions, and to obtain a proper conception of the natural relations and positions of our more common and characteristic fossil types. We have therefore sought to condense as much as possible, and to avoid all matters not immediately connected with the end in view.

the generality of Canadian rocks, are comparatively of little interest. Throughout the broad areas occupied by our Silurian strata, (as in other parts of the world,) only fucoids or seaweeds appear to occur. It is in the Devonian formations that land plants are first met with; but in Canada, with the exception of Gaspé in the extreme east of the Province, obscure traces of these forms have alone been discovered. In Western Canada, as in the case of the underlying Silurian strata, our lower Devonian beds have only yielded fucoidal types, and it is merely in the limited patches of the Chemung and Portage Group (see PART V.) that fragmentary remains and impressions of terrestrial forms occasionally occur. Long furrowed stems, several feet in length, and varying in diameter from an inch to three inches, occur in the dark bituminous shales of that formation, at Cape Ipperwash (Kettle Point,) on Lake Huron. These have been referred to *Calamites*, a genus of sub-aquatic or marsh plants of common occurrence in the coal strata, but their character is still obscure. The fossil plants of Gaspé are described in valuable papers by Dr. Dawson of Montreal, in the fifth and sixth volumes of the *Canadian Naturalist*. In fig. 64 we give a sketch of a common but still unnamed fucoid from the Trenton limestone of Belleville and other parts of Canada. Fig. 65 represents another supposed fucoid, the *Scolithus linearis* of Hall, from the Potsdam sandstone of the County of Leeds, C. W., and other districts (see PART V.) It forms, in general, cylindrical or flattened reed-like casts, varying in length from a few inches to a couple of feet, and traversing the strata across the direction of their bedding. The true nature of these casts, however, is still involved in doubt. By some palæontologists they are looked upon as resulting from holes or tubes made by sand-burrowing annelides. Finally, it may be observed that impressions of modern leaves (*Thuja, Populus, Acer, &c., &c.,*) are occasionally found in our drift clays and shell marl deposits (see PART V.)

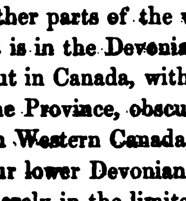

Fig. 64.

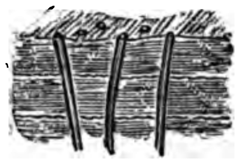

Fig. 65.

Fossilized Animal Remains:—Keeping always before us the fact that this Essay is addressed strictly to the general reader, it will be necessary, before adverting to the animal remains occurring in Cana-

dian rocks, to pass briefly in review the classification-characters of the leading zoological groups as recognized in existing Nature. Animal organisms appear to be constructed after five principal types: the so-called Protozoic type, the Radiated type, the Molluscous type, the Articulated type, and Vertebrated type.

PROTOZOA stand upon the extreme and oscillating limit of the Vegetable and Animal worlds. They include a series of *Infusorial forms*, in great part of vegetable origin, *Sponges* and *Rhizopods*. RADIATED ANIMALS exhibit, at least in their typical forms, a radiated arrangement of their structural parts, as seen in the coral polyp, the sea-urchin, and the starfish. They are all aquatic, and chiefly marine. MOLLUSCOUS ANIMALS, as the name implies, are soft-bodied, and the greater part secrete an external calcareous shell, as in the oyster and the snail. In some few, however, the shell is internal, as in the cuttle-fish; and some again, as the common slug, are without a shell, or possess merely the rudiments of one. ARTICULATED ANIMALS comprise insects, crustaceans (as the lobster, crab, &c.,) and other forms with usually a distinctly jointed body, covered in many instances by a hard integument or even by a shell. Finally, VERTEBRATED ANIMALS possess an internal skeleton, of which the principal and most persistent part is the vertebral column. They include fishes, batrachians, (as newts and frogs,) reptiles, birds, and mammals.

Since the first creation of living things, representatives of each of these great types—that is to say, of the Radiated type, the Molluscous type, &c.,—probably peopled the earth in each and all of its varied periods of development; but hitherto, traces of vertebrated forms have escaped detection in the lowest fossiliferous rocks, fishes first appearing in Europe at the extreme top of the Upper Silurian deposits, and with us, in the Devonian strata.

Protozoa.—This sub-kingdom includes: INFUSORIA, SPONGES, and RHIZOPODS.

INFUSORIA.—These are microscopic organisms, for the greater part, if not wholly, of vegetable origin, although (as in the case of the well-recognized spores or earlier stages of development of many cryptogams) possessing powers of locomotion. Recent Infusoria occur in all waters in which decomposed matters are present, and they are frequently found also in clear running streams. Some are entirely soft-bodied, but others are protected by a calcareous, siliceous, or ferruginous shell. The microscope has shewn that many bog-iron deposits,

siliceous marls and tripolis are almost entirely made up of the remains of these creatures. Beds of tripoli occur at Laval and Lanoraie (Sir W. E. Logan) in the Lower Province, but their infusorial forms do not seem to have been specially examined.

SPONGES.—Modern sponges consist of a gelatinous mass, full of pores, and possessing in general the power of secreting a horny framework or kind of skeleton—the "sponge" of commerce. This horny framework is commonly strengthened by a number of sharp spines or spicula, crossing each other in various directions. The spicula are either siliceous or calcareous, according to the species. Fossil spicula often occur in flints and in infusorial deposits. Dr. Dawson has also detected them in the Drift deposits of Montreal, (see Part V.) The ancient sponges appear to have secreted a hard calcareous framework, and to have been more nearly related to corals. If we except the doubtful *Stromatopora* or *Stromatocerium*, (see under "corals," further on) our Canadian rocks do not appear to have yielded any determinate forms.

RHIZOPODS (or FORAMINIFERA.)—The animals of this class are aquatic, and, with few exceptions, of extremely minute size. They swarm in many of our seas. Their soft gelatinous body is sometimes naked, or enclosed in a horny capsule; but more commonly it is protected by a calcareous and usually many-chambered shell, perforated for the passage of long and delicate filaments, whence the name of the class, from ῥιζα, a root. The latter forms, or those possessing shells, are generally known as *Foraminifera*. The only representatives of these in Canadian Deposits occur in the Drift or Post-Pliocene accumulations of Montreal and its vicinity, where they were discovered by Professor Dawson. (See illustrations and descriptions in the Canadian Naturalist, vols. 2 and 4.) All have been recognised as identical with existing forms. Fig 66 is a greatly enlarged view of the most common species, *Polystomella umbilicatula*.

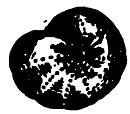

Fig. 66.

Radiated Animals.—The following Classes belong to this division: POLYPIFERA OF CORALS, ACALEPHA, and ECHINODERMATA.

CORALS.—The fossil forms of Canadian occurrence referred to this class may be conveniently arranged in two groups: *Graptolites* and *Corals proper*. The true position of the graptolites, however, is exceedingly uncertain; but the general opinion allots them a place

near the Virgulariæ or sea-pens, belonging to the lower of the two great orders or divisions in which modern forms of this class are mostly arranged. It should be observed, nevertheless, that some naturalists divide the POLYPIFERA into three Orders—*Hydroida*, *Alcyonaria* and *Zoantharia* (or groups with other names synonymous with these)—and place the graptolites (with the modern *Sertularia*, &c.,) in the first order. Agassiz, again, removes this order to the class ACALEPHA.

Graptolites.—The common form of the graptolite-structure is that of a narrow band or "stipe," with a row of "teeth," *i.e.*, the mouths of cells, on one or on both sides. The teeth or serratures are pointed or even mucronate in some species, and obtuse in others. Sometimes in place of forming a narrow band, the cell-structure takes a leaf-like shape, and at other times it assumes a spiral or convolute form. Specimens have also been found, more especially in the Quebec group of rocks in the vicinity of Point Levi, in which several stipes cross each other or radiate from a common centre, around which there is a thin connecting membrane. Our ordinary examples, it is thus evident, are merely fragments of the true graptolite-structure; and as some of these occur in branching forms, of which the branches are only toothed on one side whilst the main stem is toothed on both margins, it is more than probable that the same species has been described in some instances under different names. *Being entirely confined to the Silurian strata*, the graptolites are especially interesting and valuable as geological test-forms. On this continent they are chiefly characteristic of the Lower Silurian division, (see PART V.) By some authors, the forms with serratures on each side of the stipe are described under the generic name of *Diplograpsus*; and those with serratures on one side only, under that of *Graptolithus*.

As examples of Canadian forms, we may cite at present *Graptolithus Logani*, Fig. 67. from the base of the Lower Silurian formation; *Graptolithus* (or *Diplograpsus*) *pristis*, Fig. 68, with acute or submucronate serratures, from the Trenton limestone, Utica Slate, and Hudson River group of the same formation; *G.* (=*Diplograpsus*) *ramosus*, with obtuse or somewhat truncated serratures, Fig. 69, from the Utica Slate and Hudson River group (Lower Silurian); and *G. priodon*, (=*G. clintonensis*, Hall) Fig. 70, with reversed serratures, from the Clinton and Niagara group of the Upper Silurian series.

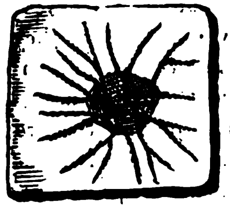

Fig. 67.

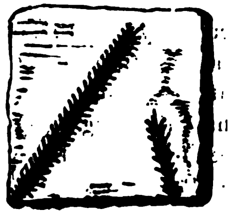

Fig. 68.

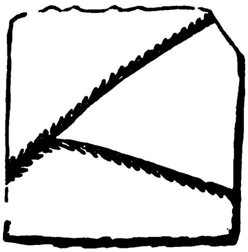

Fig. 69.

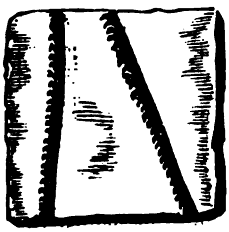

Fig. 70.

Corals proper :—The animal substance of corals consists of a soft gelatinous mass containing one or many digestive sacks or stomachs, each provided at the opening or upper part with a number of retractile tentacles. These sacks with their tentacles are technically known as "polyps." The gelatinous mass possesses likewise (in the majority of cases) the power of secreting amidst its tissues a calcareous or horny framework, the "coral" of popular language. As a general rule, this secreted solid portion consists of one or more cavities or cells, in and around which the organized fleshy sack or polyp is contained. This, however, is not always the case. Sometimes, as in the celebrated "Red Coral" of the Mediterranean, the polyp-cavity is fashioned in the midst of the gelatinous matter, without any corresponding cavities in the support. When cells occur in this support or "corallum," they exhibit either a round, oval, or polygonal opening; and, if more than one in number, they are either in juxtaposition, or connected by short transverse tubes, or by a mass of more or less porous tissue called "cœnenchyme." The cell is sometimes smooth

within, but more commonly it is furnished with a number of radiating plates or lamellæ. These, in some forms, are but slightly developed, or occur only in a rudimentary condition; whilst in others they extend far into the cell, and even unite there in a central column. A central column or "axis" sometimes, however, exists by itself, and may have radiating lamellæ of its own projecting towards the circumference of the cell; but this latter modification is not observed in any of the Palæozic types. Whether radiating lamellæ are present or not, the cell is very generally divided horizontally by a series of transverse plates or "diaphragms," either extending across the entire cell (Fig. 71, *a*, which shows three cells thus divided) or occupying the central

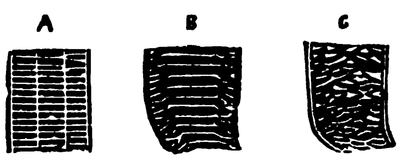

Fig. 71.

portion of this, whilst the sides are filled with small and more or less irregular plates, called "vesicular tissue," (Fig. 71, *b*). In the genus *Cystiphyllum*, again, the interior of the cell is entirely filled with these irregular vesicular plates (Fig. 71, *c*). Finally it may be mentioned that many corals possess an enveloping wall or sheath. This is termed an "epitheca."

The following are the more important or characteristic fossil species met with in Canadian rocks:

1. *Stromatocerium rugosum*, Fig. 72.—In this form, there are no apparent cells, but the corallum is made up of numerous concentric and wavy lamellæ. Lower Silurian: Trenton group*; more especially abundant at the lower part. This fossil is also known as *stromatopora rugosa*, and is sometimes classed as a sponge. A closely related species, *Stromatopora concentrica*, occurs in the Niagara group of the Upper Silurian series, and passes in some districts into the Devonian rocks.

Fig. 72.

* The subordinate divisions of our Silurian and Devonian strata will be found described in full in Part V.

2. *Stenopora fibrosa* (= *Chætetes lycoperdon*) Fig. 73. This form is made up of long fibrous or acicular tubes, with numerous transverse diaphragms. These latter, however, to be properly seen, require the aid of a magnifying glass. The corallum is either globular, hemispherical, dendritic, or irregular. The dendritic forms often resemble sea-weeds, but, except in much weathered specimens, a magnifying glass will generally show their punctured surface (the openings of the cells), and their delicately fibrous structure. Very common throughout the Trenton Group, Utica Slate, and Hudson River Group of the Lower Silurian Series. Found also in the Upper Silurian rocks.

Fig. 73.

3. *Favosites Gothlandica* (= *F. Niagarensis*) Fig. 74.—The corallum in this species is properly hemispherical and sometimes of large size, but specimens are generally obtained in the form of irregular masses. These are made up of hexagonal or polygonal cell-tubes with numerous transverse diaphragms, and with pores in the cell walls. They are the "petrified honeycombs" of quarrymen, &c. Principally Upper Silurian; but found occasion- in the Lower Silurian and frequently in the Devonian Series.

Fig 74.

4. *Michelinia convexa*, Fig. 75.—The corallum in this species consists of large but shallow polygonal cells, with convex and in part vesicular diaphragms, and pores in cell walls. Devonian strata, Canada West.

Fig. 75.

5. *Halysites catenulatus* (= *Catenipora escharoides*), fig. 76.—In this species, the well-known "chain coral," the oval cell-tubes are united in chain-like groups. There are numerous diaphragms, and some rudimentary radiating-lamellæ. Chiefly characteristic of the Clinton and Niagara group (Upper Silurian), but found also of late years in the Lower Silurian series.

Fig. 76


Fig. 77.

6. *Syringopora tubiporoides*, Fig. 77.—The corallum in this form consists of round, elongated, and somewhat flexuous tubes, connected by tranverse tubes of short length. Another species, *S. Hisingeri*, resembles this, but its tubes are of much smaller diameter. Both occur in the Devonian rocks of Western Canada.


Fig. 78.

7. *Columnaria alveolata*. Fig. 78.—This species much resembles *Favosites Gothlandica*, the corallum being made up of hexagonal and polygonal cells in close juxtaposition, but the mouths of the cell-tubes are bordeied by short radiating lamellæ. Numerous diaphragms are also present, but the cell-walls have no pores. Trenton group (Lower Silurian), and principally met with at the lower part of this group (= Black River limestone, see PART V.)


Fig. 79.

8. *Petraia cornicula* (= *Streptelasma* of Hall) Fig. 79. Corallum horn-shaped, simple, consisting of one large cell with well-developed radiating lamellæ, but without diaphragms. Trenton Group (Lower Silurian). A closely related species from the Niagara Group (Upper Silurian) has been named *P. calicula*. Another species, *P. profunda*, from the base of the Trenton Group, has a conical and nearly straight form. All of these vary in length from about half an inch to an inch and three-fourths.


Fig. 80.

9. *Zaphrentis prolifica*, Fig. 80.—Corallum, horn-shaped, simple; with alternating largeand small radiating lamellæ, and transverse diaphragms. A "septal fossette" or indentation passes down the interior of the cup on one side; and externally, the corallnm is enveloped in a thin epitheca. This is a comparatively large species, varying in length from about an inch and a half to over five inches; but a still larger species, *Z. gigantea*, is often found accompanying it. This latter form is two or three inches in diameter, and two feet

or more in length. Both occur in the Devonian series (Corniferous limestone (see PART V.) of Western Canada.

10. *Cystiphyllum Senecaense* (Billings) Fig. 81 (a fragment); Corallum horn-shaped, simple, slender, and usually curved. Interior filled with vesicular tissue. Radiating lamellæ quite rudimentary. Diameter three-fourths of an inch, to an inch and a half. Length, varying from three or four inches to two feet (Billings). Devonian rocks (corniferous limestone) of Canada West. Various other species of Cystiphyllum occur in these rocks. Amongst others, *C. aggregatum* (Billings), in groups of irregularly cylindrical tubes covered by a wrinkled epitheca.

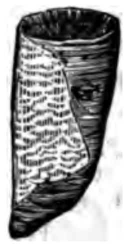

Fig. 81.

These corals represent our most abundant and characteristic species, but numerous others occur in special localities. For information respecting many of these, the reader is referred to the Reports of Mr. Billings in the publications of the Canadian Geological Survey, and also to valuable memoirs by that palæontologist in the fourth and fifth volumes of the *Canadian Journal*. An extended analysis of these forms would not only exceed our proposed limits, but would be altogether out of place in an Essay like the present.

ACALEPHA.—Until lately, this class was held to include only a series of soft-bodied marine animals (*Medusæ*, &c.,) of which no fossil representatives have as yet been obtained. The recent researches of Professor Agassiz, however, render it very probable that the Graptolites and some of the lower forms usually classed amongst the corals may belong to this division.

ECHINODERMATA.—The echinoderms constitute a class of marine animals provided with an external test or shell, composed of many pieces, or with a tegumentary semi-calcareous skin. Some are free, and others, fixed animals. These latter are attached to the sea-bottom by a jointed calcareous stem; but in some instances the animal is only thus attached during a portion of its life, and becomes free in the adult condition. The class may be subdivided into the following Orders: 1, Crinoida; 2, Blastoida; 3, Cystidea; 4, Thyroida; 5, Asterida; 6, Ophiurida; 7, Euryalida; 8, Echinida; 9, Holothurida.

1. *Crinoida.*—In the majority of fossil crinoids or encrinites ("sea-lilies"), the general form consists of a body or digestive sack, covered by calcareous plates, and furnished at its upper part with a series of jointed arms or tentacles, and at its lower part with a jointed and perforated stem (composed of numerous round or pentagonal plates) by which it was attached to the sea-bottom: see fig. 82 This Order is of great palæontological interest. In the seas of the Palæozoic and Mesozoic periods, its representatives swarmed in vast numbers; whilst but few forms belonging to it have been obtained from Tertiary rocks (see the Table of Formations on page 453 above); and in existing seas the order is almost extinct, two or three species alone remaining to represent it. The best known of these is the *Pentacrinus caput-Medusæ* of the West Indian seas. A small species of *Comatula* exists also in the Irish Channel, and of late years has been carefully studied. This form is fixed by a stem in the early condition, and afterwards becomes free. The fixed stage was originally thought to be permanent, and the species was known as *Pentacrinus Europæus.* The genus *Marsupites,* of the Cretaceous rocks, was also a free form, during a portion, if not during the entire period, of its life.

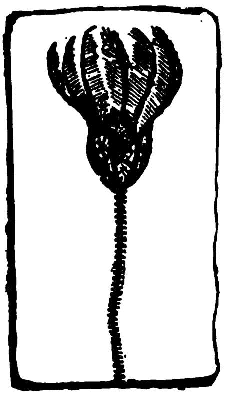

Fig. 82.

The cup-shaped body of the crinoid animal is technically termed the "calyx." It is enclosed by numerous polygonal plates, arranged, for each genus, in definite order. The plates in a row immediately above the stem are commonly known as "basals." These are usually three or five in number. The next series, absent, however, in many genera, are called sub-radials, and the next, supporting the base of the arms, are known as "radials." The radials always range in five vertical rows, each row being made up of one or several plates, between which occur other plates, termed inter-radials and anal plates. The upper part of the calyx is covered (in most genera) by numerous small and irregular plates, termed, collectively, the "vault." The vault-plates are sometimes prolonged into a so-called "trunk," the office of which is still undetermined. In some species the vault has two openings, in others only one.

Numerous stem-fragments of crinoids occur throughout our Silurian and Devonian rocks, but entire or even tolerably perfect forms are exceedingly rare. As the character of the stem differs frequently in the same species, and in different parts even of its own length, and is more or less alike again in different species, these fragments can only be described as "crinoid stems." Fig. 83 represents a piece of arenaceous shale, from below the Drift clay of Toronto, covered with portions of crinoid stems, some being seen in transverse sections, whilst others are shewn longitudinally. This shale belongs to the Hudson River Group of the Lower Silurian Series (see PART V.)

Fig. 83.

Owing to this fragmentary condition of our Canadian examples generally, and to the great rarity of perfect or determinable forms, it is unnecessary in an essay like the present (and would indeed be useless where we are obliged to restrict the number of our engravings) to attempt descriptions of genera and species. The crinoids of our Lower Silurian strata will be found described in great detail by Mr. Billings, in the fourth Decade of "Canadian Organic Remains."* Of the species met with in our other formations, no complete record has yet been published.

2. *Blastoida*.—The forms placed in this Order have been separated of late years from the Crinoids proper. They present an oval or globular body, (the calyx) composed of several series of plates, and having at the summit five "ambulacral areas" or rays, in the shape of a star, furrowed down the centre of each ray, and striated across. These are thought to have supported delicate tentacles, but no arms have been discovered. The body was fixed to the sea-bottom by a short, jointed stem. The order contains but few genera. The genus

* In further illustration of the inutility of entering into descriptions of these forms in the present place, it may be observed that, of several species described and figured by Mr Billings, only single specimens are known. We have therefore thought it advisable to restrict, for the greater part, our limited number of engravings to representations of characteristic or commonly-occurring corals, brachiopods, lamellibranchiates, gasteropods, cephalopods, and trilobites.

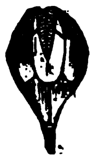

Fig. 84.

Pentremites (fig. 84) is the principal. It is chiefly characteristic of the Devonian and Carboniferous formations. A closely related form—separated generically under the name of Blastoidocrinus*—has been described by Mr. Billings from the Chazy limestone of the Trenton Group, a member of the Lower Silurian series, (Canadian Organic Remains: Decade IV.)

3. *Cystidea.*—The representatives of this Order are more or less closely allied to the crinoids. The cystideans possessed a globular or oval body attached to the sea-bottom by a short stem. The body was covered by polygonal plates, which in some genera were arranged in definite order, and in others, irregularly. Arms were either rudimentary or altogether wanting. The body openings were three in number, comprising (according to the more general view) an oral, anal, and ovarian aperture. The latter (or according to some palæontologists, the oral orifice) was surrounded by five or more triangular plates, forming a kind of pyramid. In addition to these openings, most genera exhibit a series of pores, either distributed irregularly over the body-plates or collected into lozenge-shaped areas termed "pectinated rhombs," see Fig. 85 (= *Glyptocystites Logani*, Billings).

Fig. 85.

The cystideans were limited entirely to the Silurian period. Not a trace of this Order is found in the rocks of any succeeding epoch. Various species, but mostly in a very fragmentary state, occur in our Canadian strata. These are illustrated and described by Mr. Billings in Decade III. of *Canadian Organic Remains*. The following is an analysis of the leading forms, extracted from a review, by the writer of this Essay, in the Fourth Volume of the *Canadian Journal* (*New Ser.*):

"With regard to the Lower Silurian species of Canadian cystideæ, Mr. Billings describes nineteen new forms, belonging to his genera, Pleurocystites, Glypto-

* *Pentremites* exhibits three series of plates (exclusive of the Ambulacroid series): Basals Radials, and Inter-radials, the latter resting upon the radials in alternate position. The radials are comparatively large, the inter-radials small, so that the ambulacroids extend nto the former. In *Blastoidocrinus* the reverse of this takes place. The inter-radials are large, and the ambulacroids do not extend below them.

cystites, Comarocystites, Amygdalocystites, Malocystites, Palæocystites, and Ateleocystites. The genus Pleurocystites is a very remarkable one. It is chiefly characterised by the dissimilar structure of the two sides of the body; a series of comparatively large plates covering the dorsal side, whilst the ventral side consists of an open space protected by an integument covered with numerous small plates. The genus, with us, appears to range from the Chazy to the Hudson River group; and geographically from Canada to Wales and Bohemia (Caradoc group and Barrande's *étage D.*) Six species are enumerated: *P. squamosus* (plates plane or slightly concave; pectinated rhombs, with obtuse angle above); *P. robustus?* (plates concave); *P. filitextus* (pectinated rhombs with acute angle above; plates on ventral side fewer and larger than in *P. squamosus*); *P. elegans*; *P. exornatus*; and *P. Anticostiensis* (plates probably smooth). *P. elegans* and *P. ornatus* may perhaps prove eventually to be mere varieties of *P. filitextus*. The genus Glyptocystites is characterised chiefly by its cylindrical body, enclosed in four series of plates (= 4 basal + 5 + 5 + 5) some with re-entering angles; and by the presence of *ten or more* pectinated rhombs, a strikingly peculiar character. It ranges from the Chazy to the Trenton group, and comprises the following species: *G. multiporus* (arms 4+ 1, extending down the sides of the body); *G. Logani* (plates with stellar ridges, arms not developed: Trenton): *G. gracilis*; *G. Forbesi* (plates large and strong, with numerous ridges and striæ: Chazy). Of the genus Comarocystites only one species, *C. punctatus*, has been recognised. It occurs in the Trenton group, and may be readily distinguished by its deeply-concave plates. The basal plates are three in number, succeeded by from eight to eleven irregular rows; the mouth is provided with a valvular apparatus, and there are *free arms*. The genus Amygdalocystites possesses the same plate-formula as Comarocystites, and the mouth is also furnished with a valvular apparatus; but, in addition to other distinguishing characters, the arms are recumbent, and composed of a double in place of a single series of joints. Three species are enumerated. One of these, however, may belong to a distinct genus, and the other two may perhaps be united. They comprise: *A. florealis*, *A. tenuistriatus* (?), and *A. radiatus*. In both Comarocystites and Amygdalocystites the plates are without pores, at least on the unworn external surface. The genus Malocystites has likewise an indefinite number of non-poriferous plates.* The arms are recumbent, and the mouth is nearly at the apex of the cup. Two species are described: *M. Murchisoni*, with eight long and winding arms, and *M. Barrandi*, with two short arms. In the genus named Palæocystites, the plates are numerous and also poriferous, or rather crypto-poriferous, as the pores do not extend directly to the outer surface, but communicate with the interior through the sutures, on the edges of which they open. Nothing is known respecting the arms, orifices, and stem. Three species are enumerated: *P. tenuiradiatus*,† *P. Dawsoni*, and *P. Chapmani*,

* As subsequently shown, however, by Mr. Billings, the pores in Comarocystites appear to open out on the sides of the plates at the sutures, as in the genus Palæocystites. May not this be the case, also, with regard to Cryptocrinus (Von Buch), and the other so-called non-poriferous types?

† This is the *Actinocrinus tenuiradiatus* of Hall. The other species appertaining to the different genera enumerated in the text, belong entirely to Mr. Billings.

[illegible] describes [illegible] are placed [illegible] observed, are [illegible] obtained are still more [illegible]

Palasterina.—Five rays, with intermediate connecting area.

P. stellata, more or less regularly pentagonal.

P. rugosa, dorsal plates in part stelliform (ventral aspect unknown.)

Petraster.—Connecting area very slightly developed. Large marginal plates. *P. rigidus*, (characters imperfectly known.)

Stenaster.—No connecting area. Rays without spines or overlapping plates. *S. Salteri*, rays comparatively broad.

S. pulchellus, rays long and narrow.

Tæniaster.—No connecting area. Rays narrow, covered in part with spines, and with their outer, or adambulacral, plates partly overlapping. *T. spinosus; T. cylindricus.* (The latter of these is apparently the larger and more robust species of the two, but otherwise the characters are much alike).

In addition to these forms, small and more or less imperfect specimens of Asterida, probably referable to Hall's genus Palæaster, are occasionally obtained from the Niagara limestone of the Upper Silurian Series.

6. *Ophiurida.*—The star-fishes of this Order differ from the Asterida proper, in having their arms or rays quite distinct from the central visceral-cavity. With the exception of a doubtful fragment from the eastern Post-Tertiary deposits (see *Part V.*), no examples have as yet been noticed in Canadian rocks.

7. *Euryalida.*—In this Order, the arms and stomach are also distinct, but the body is only partially covered by calcareous plates. No fossil representatives.*

8. *Echinida.*—This is an important Order, but fossil representatives, are all but unknown below the Mesozoic rocks, and none (with the exception of a modern form in the Post-Tertiaries of Beauport, see Part V.) are of Canadian occurrence. The echinids, of which the modern "sea-egg" or "sea-urchin" may be taken as a type, have no arms. The body is hemispherical, oval, cordiform, &c., and covered by a calcareous test or shell, composed of polygonal plates joined at their edges. Some of these plates, in radiating areas termed "ambulacra," are perforated for the passage of retractile respiratory tubes. The test, moreover, is covered by moveable calcareous spines (which fall off after the death of the animal); and it has always two openings, one of which, the mouth, is invariably situated on the under side of the body. In existing seas these forms are exceedingly abundant, and they appear to have been equally numerous in the seas of the Cainozoic and Mesozoic ages (see Table of Formations, page 453, above).

* The *Protaster* of E. Forbes is now referred to the Ophiurida.

In the Palæozoic deposits, on the other hand, only three or four genera have been met with, and examples of these are rare. As already remarked, our Canadian rocks of this age have not yet offered any representatives of the Order.

9. *Holothurida.*—This Order comprises various more or less soft-bodied marine animals, of which the Holothuria or "sea-cucumber" may be taken as a type. Fossil representatives are of exceedingly doubtful occurrence. None belong to Canadian rocks.

This concludes our rapid sketch of the sub-kingdoms PROTOZOA and RADIATA. The MOLLUSCA and other types will come under review in our next Number.

OBSERVATIONS ON THE EXISTENCE OF VARIOUS MOLLUSKS AND ZOOPHYTES AT GREAT SEA DEPTHS.

BY M. MILNE EDWARDS.

(*Translated from the Comptes Rendus of July* 15, 1861.)

A more accurate knowledge of the depths assigned by Nature to the various species which inhabit the sea, has been rendered especially desirable by the bathymetrical researches of the late Edward Forbes and other observers, and also by the relations which appear to obtain between the existing and geological distribution of marine animals. I have therefore eagerly availed myself of all opportunities which seemed favorable for the prosecution of this class of observations.

M. Valenciennes has kindly presented me with several shells possessing much interest from the remarkable depths at which they were obtained. One of these is the *Voluta Junonia* (Sch.) found by Capt. B. Letourneur in the Gulf of Mexico at a depth of about 130 metres [=426½ feet]. Another belongs to *Lima excavata,* dredged by M. Hoeg at 487 metres [=1597·8 feet] off the coast of Greenland. This latter station much exceeds the lowest zone hitherto assigned to the habitations of marine mollusks, but other facts which I am about to describe, have proved the existence of these forms, and also of corals, at still greater depths.

The telegraphic communication between the island of Sardinia and the coast of Algeria having been interrupted, it became necessary to raise the cable, in order to examine the alterations to which this had been subjected. In carrying out this operation, the engineers made a careful study of the configuration of the sea-floor on which the cable rested, and determined with great accuracy, from point to point, the various depths at which it lay. In addition to this, and in order to obtain a further insight into all the circumstances which might have affected this sub-marine conductor, the foreign bodies found attached to it in different places were carefully preserved. Thanks to the kindness of M. Mangon (*Professeur à l'école des Ponts et Chaussées*), I have been enabled to examine several pieces of the cable; and I have thus had it in my power to ascertain some new facts with regard to the existence of certain animal species at depths in which it is usually considered impossible for animals to live.

A wide sub-marine valley, at a depth of between 2,000 and 3,000 metres [roughly, from 6,000 to 10,000 feet], extends from the island of Sardinia to the coast of Algiers. Between Bône and Cagliari the cable lay in this depression; and it had remained there about two years when the engineers commenced their operations upon it. In attempting to raise the cable, it broke, and a portion only was recovered. This was brought up from a depth of from 2,000 to 2,800 metres [=6561·8 to 9186·5 feet], and detached pieces were submitted to my examination. Amongst the foreign bodies which adhered to it, I found several corals and various mollusks, all living when first withdrawn from the water. One of the mollusks was a species of oyster, (*Ostrea cochlear*), a species which occurs abundantly in many parts of the Mediterranean, and which is known to be a deep sea form, as it is frequently found in the dredges of the coral fishermen, whose operations are generally carried on at a depth of 100 or 150 metres [=328 to 492 feet]. In the case observed, the animal was evidently attached to the cable when quite young, since its lower valve, measuring two and a half inches across, was completely moulded on the surface of the rope, and so curved as to embrace about half the circumference of this. To another part of the cable was also attached, though less firmly, a small species of Pecten, *P. opercularis* (var. *Andouini*), common enough in the Mediterranean. I obtained, likewise, another species of that genus, *P. Testæ*, an exceedingly rare form. Its valves are covered with fine and delicately reticulated striæ. M. Filippi

alludes to the species as being only met with at great depths, that is to say, from 50 to 60 metres (164 to 197 feet). Associated with these three acephalous mollusks, were two gasteropods belonging to species of rare occurrence in localities usually explored by zoologists. One is the *Monodonta limbata;* the other, *Fusus lamellosus.* The shell of this latter, characterised by the fine striæ which traverse the whorls, was in a perfectly fresh condition, and contained, equally with the *monodonta,* the soft parts of the animal. These mollusks, it is therefore evident, were living at the spot from which they were obtained.

The corals living at these great depths offer still more interest. Those procured, number fourteen examples, belonging to three species of the Turbinolidæ. One does not appear to me to differ in any respect from the *Caryophyllia arcuata,* a very rare species, met with in the fossil state in the Upper Tertiary deposits of Castel Arquato, Piedmont, and which occurs likewise at Messina. Another species of the same genus, closely related to *C. clavus* but which is yet distinct, and so may be designated as *C. electrica,* seems to be much more abundant in the sub-marine valley in which the cable reposed, since I found ten individuals attached to the wire and bearing evident marks of having been developed upon this. I should add that this small species appears to be identical with a fossil coral of the Pliocene subdivision, discovered by M. Deshayes at Donera in Algeria. I am not able to refer to any established genus a third form of the Turbinolidæ, which was also attached to the same portion of the cable. This little coral, about one centimetre in length, does not exhibit the central axis of the *Caryophylliæ.* It seems to occupy an intermediate position between the genera *Ceratotrochus* and *Sphenotrochus.* I propose for it the name of *Thalassiotrochus telegraphicus,* to recall at one and the same time, its zoological affinities, its open-sea habitat, and the circumstances which led to its discovery. Finally, I should observe that to the same portion of the cable was attached a little branch of Bryozoons of the genus *Salicornaria* (*S. Farciminiodes*) ; and also several *Gorgonidæ,* and two species of *Serpulæ.* The calcareous tubes of the latter were of some size, and soldered to the wire along a considerable length. The serpulæ of the Mediterranean are too imperfectly known, however, to allow these annelids to be specifically determined, but I believe they may be referred to two distinct species.

We thus perceive that at the bottom of a part of the Mediter-

ranean, with a sea-depth varying between 2,000 and 2,800 metres [=6561·8 to 9186·5 feet], a considerable number of animals, of completely sedentary habits, are actually living. Most of these, moreover, belong to species of reputed rarity; and some have hitherto escaped the observation of zoologists. It is likewise to be remarked that several of these forms do not appear to differ from certain fossil species, the remains of which are imbedded in the Upper Tertiary deposits that occur on opposite sides of the same basin. These results, it is thought, are not altogether devoid of interest, whether regarded geologically or in a zoological point of view; and they lead us to expect that a more complete exploration of the depths of the sea will bring to light the existence of other species supposed to be extinct because found hitherto only in the fossil state. Physiologists will perhaps, also, think the fact worth recording, that animals, as highly organised as gasteropodous mollusca, are able to live under a pressure of more than two hundred atmospheres, and at depths to which no notable quantity of light can possibly penetrate. E. J. C.

ON GREAT FLUCTUATIONS OF TEMPERATURE IN THE ARCTIC WINTER.

BY J. J. MURPHY, ESQ.

(*From the Proceedings of the Royal Society, June* 7, 1861.)

It might be expected that the climate of the Arctic Regions during winter, in the absence of the sun, must be almost a dead level of intense cold; but so far is this from being the case, that there is no other place and time where such great and rapid fluctuations of temperature have been observed.

This phenomenon is thus mentioned in the appendix to Wrangell's account of his expedition to the Siberian coasts of the Polar Sea:—

"Sometimes in the middle of winter a wind from the S.E. by E. causes the temperature to rise suddenly from -24° to $+25^\circ$, or even $+32^\circ$; previously to this, the barometer sinks as much as four-tenths of an inch in the course of eight hours. The S.S.E. wind has no particular influence either on the barometer or thermometer."

In "The Search for Sir John Franklin," published in No. 1 of the *Cornhill Magazine*, occurs the following notice of the same phenomenon. The *Fox* was beset by vast fields of ice somewhere in Baffin's Bay :—

"December 28. During Divine Service yesterday the wind increased, and towards the afternoon we had a gale from the north-westward, attended with an unusual rise of temperature; to-day the gale continues, with a warm wind from the N.N.W.

"The Danish settlers at Upernavik, in North Greenland, are at times startled by a similar sudden rise of temperature. During the depth of winter, when all nature has long been frozen, and the sound of falling water has long been forgotten, rain will fall in torrents; and as rain in such a climate is attended with every discomfort, this is looked upon as a most unwelcome phenomenon. It is called the *warm south-east wind*. Now, if the Greenlanders at Upernavik are astonished at a warm south-east wind, how much rather must the seamen, frozen up in the pack, be astonished at a warm north-west wind! Various theories have been started to account for this phenomenon; but it appears most probable that a rotary gale passes over the place, and that the rise of temperature is due to the direction from which the whole mass of air may come, viz., from the southward, and not to the direction of the wind at the time."

The cause here assigned appears to me quite insufficient: the rise of the thermometer that we have to account for sometimes amounts to 70° or 80°, which is equal to the difference between very warm summer weather and very hard frost in our climate; and it is unexampled, and I think inconceivable, that any motion of a mass of air from warmer latitudes should produce so great an effect on the temperature; certainly the cyclones that come from the West Indian Seas and pass over our islands have no effect in the slightest degree approaching to it.

What I regard as the true cause of the phenomenon is suggested, thongh not distinctly pointed out, in Dr. Kane's Narrative, from which I will make a few extracts :—

"January 29. A dark water sky extended in a wedge from Littleton to a point north of the Cape. Everywhere else the firmament was obscured by mist. The height of the barometer continued as we left it at the brig, and our own sensations of warmth convinced us that we were about to have a snow-storm. * * * We were barely housed before

the storm broke upon us. Here, completely excluded from the knowledge of things without, we passed many miserable hours. We could keep no note of time, and, except by the whirring of the drift against the roof of our kennel, had no information of the state of the weather. * * * We then turned in to sleep again, no longer heedful of the storm, for it had buried us deep in with the snow. But in the meantime, although the storm continued, the temperatures underwent an extraordinary change. I was awakened by the dropping of water from the roof above me; and upon turning back my sleeping bag, found it saturated by the melting of its previously condensed hoar-frost. My eider-down was like a wet swab. I afterwards found that the phenomenon of the warm south-east wind had come unexpectedly upon us. The thermometers at the brig indicated $+26°$, and, closer as we were to the water, the weather was probably above the freezing-point. When we left the brig—how long before it was we did not know—the temperature was $-44°$. It had risen at least seventy degrees. * * * In the morning—that is to say, when the combined light of the noon-day dawn and the circumpolar moon permitted our escape—I found, by comparing the time as indicated by the Great Bear with the increased altitude of the moon, that we had been pent up for nearly two days."

It appears from these extracts, that although Dr. Kane did not see open water, he was made aware of its neighbourhood by the infallible sign of a "Water Sky." A rise of temperature to a few degrees above frost would be quite insufficient to produce open water by melting through the fields of ice in forty-eight hours; but, on the other hand, the breaking up of the fields of ice by a storm is an adequate cause for a great rise of temperature; for the water immediately below the ice is at the temperature of sea-water at its freezing-point, which is $+28°$; so that when a storm comes and breaks up the ice, the water comes into contact with air 70° or 80° colder, and warms the air.

There is no doubt of the power of a storm to break up the ice. Sir James Ross speaks of "the almost magical power of the sea in breaking up land-ice or extensive floes of from twenty to thirty feet thick, which have, in a few minutes after the swell reached them, been broken up into small fragments by the power of the waves." The theory that these sudden rises of temperature are caused by storms breaking up the ice and exposing the comparatively warm water below,

also harmonizes with the fact that the warm winds, as mentioned by the officer of the *Fox*, in different parts of Baffin's Bay come from different points of the compass; while on the same coast they come from the same point. Thus Wrangell, as quoted above, mentions that in the part of the Siberian coast which he explored, a S.E. by E. wind sometimes raises the thermometer upwards of fifty degrees, while a S.S.E. wind has no effect on the temperature at all. This proves that the rise of temperature cannot be due to the transport of a mass of warm air; but it may be easily accounted for by supposing that the form of the coast enables the warmth-producing wind to act at a special advantage in breaking up or driving away the ice, and liberating the heat of the waters.

These extraordinary fluctuations of temperature appear to be common to the whole of the Arctic regions. Sir John Richardson, in his recent work on the Polar regions, states that "in Arctic America the phenomenon of warm winds (*teplot weter* of Wrangell) also occurs, and makes the month in which they happen, whether December, January, or February, warmer than the other two. The same warm wind was probably the cause of the rain which the Russian sailors observed in Spitzbergen in the month of January."

Rain implies a temperature several degrees above $+28°$, which is the temperature of the stratum of sea-water immediately below the ice. But we know that in the Polar regions the temperature of the sea increases in descending, until a stratum is reached of the invariable temperature of $+39°$; and we may suppose that in these storms the warmer water of the deeper strata is brought to the surface, and warms the air sufficiently to admit of rain. We know that powerful winds are able to produce temporary local currents, and it is easy to see that such a current when produced in a limited space free of ice, will give rise to this kind of *vertical circulation*, or interchange between strata of different depths.

Such storms as these must be eminently favourable to the production of rain; for the air that becomes warmed by contact with the comparatively warm water will, of course, take up watery vapour, and when it comes into contact with other masses of air that retain their usual intense cold, the vapour will be rapidly condensed; so that we cannot wonder at heavy rains being a general concomitant of these storms.

Wrangell, in the passages I have quoted, says the warm wind in

Siberia is preceded by a fall of the barometer. Dr. Kane, on the contrary, noticed a rise before the storm above described; it stood at "the extraordinary height of 30·85." I cannot suggest any explanation of these facts.

I believe I have now stated the true cause of what is certainly a very remarkable phenomenon—fluctuations of temperature of enormous magnitude, occurring in a very short time, and in the absence of the sun.

SCIENTIFIC AND LITERARY NOTES.

GEOLOGY AND MINERALOGY.

UNITY OF GEOLOGICAL PHENOMENA IN THE PLANETARY SYSTEM OF THE SUN. BY L. SÆMANN.

M. Louis Sæmann, of Paris, has sent us a somewhat remarkable memoir under the above title, (Sur l'unité des phénomènes géologiques du système planetaire du soleil), reprinted from a recent Bulletin of the Geological Society of France. In this communication, after bringing forward the generally received views in favour of the common origin of our sun and its planetary masses, and their analogous chemical composition under different states of condensation, the author discusses in detail the peculiar condition of the moon, as apparently hostile to his theory. The absence of water and of an enveloping atmosphere (properly so-called), are of course the points thus chiefly brought under consideration. M. Sæmann regards the moon as having passed through various phases, which the earth is also in its turn eventually destined to witness. The smaller mass of the satellite has led to a more rapid development of these phases, than in the case of the larger earth mass. Both air and water he conceives to have once existed in the moon, and to have been gradually absorbed by the rock-matters of which this is made up; and the air and water of the earth, it is argued, must in the course of time be equally absorbed. In support of this view, the author enters into various calculations, based chiefly on the experiments of M. Durocher (Bulletin de la Societé Géologique, 2e sér., vol. x.) on the absorption of moisture by rocks generally, and he shews this to be much in excess of that which would arise from the complete absorption of the oceanic waters by the solid mass of the earth. Thus, he assumes the weight of the ocean to be one twenty-four thousandth part of the weight of the land; or, reducing all to one hundred parts, he makes the land equal to 99·9958, and the water to only 0·0042. On this assumption, if all the water were absorbed, the earth would be hydrated (so to say) to the extent of 0·000042, a mere nothing

as compared with the absorptive powers of even the hardest rocks and minerals Certain feldspars, for example, became hydrated, in M. Durocher's experiments, to the extent of 0·0041, others to the extent of 0·0077, &c., and some even to that of 0·0269. In sandstones, limestones, and other ordinary rocks, the absorption is, of course, very much greater than this. The water absorbed would gradually produce, it is considered, definite hydrated compounds, and so remain fixed, more especially as the earth's internal heat became more and more diminished. With regard to the probable absorption of the atmosphere, M. Sæmann enters into computations of a similar character, basing his views, as far as possible, on the actual results of experimental inquiry, and bringing forward in this connexion many collateral questions of much geological interest. Our present limited space forbids, however, a more extended analysis of this important memoir.

ON THE SUPPOSED RELATIONS BETWEEN THE ROTATION OF THE EARTH AND THE GYRATORY MOVEMENTS WHICH TAKE PLACE IN LIQUID BODIES UNDER CERTAIN CONDITIONS.

In the *Comptes Rendus* (Tome xlix., p. 637) M. Perrot inserted a note, previously read before the *Académie des Sciences*, on the gyratory movements of water flowing through a circular aperture at the bottom of the enclosing vessel, in which he maintained that this movement (in the northern hemisphere) always took place from left to right, a peculiarity due to the diurnal movement of the earth. This view being opposed to the researches of M. Magnus, published at length in *Poggendorff's Annalen*, *Mai*, 1855, the subject has been reinvestigated by M. F. Laroque (*Annales de Chimie, etc.*, *Mars*, 1861). The experiments of this latter observer appear to confirm fully the results of M. Magnus. According to M. Laroque, the rotatory motion arises from accidental causes, is irregular in its direction, and is thus in no way dependent on the rotation of the earth

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MINERALOGICAL NOTICES.

Quartz in Meteoric Iron:—G. Rose (*Ber. d. Akad. d. Wissensch, zu Berlin*, 1861, *p.* 406), has announced the discovery of a minute but perfectly distinct crystal of quartz in the Meteoric iron of Xiquipilco in Mexico. This iron is nickeliferous, and is mixed with *Shreibersite* and with particles of a simple sulphide of iron. In the valley of Toluca, in which Xiquipilco lies, fragments of meteoric iron are scattered over a very considerable area. Eight specimens from this locality, belonging to the Royal Mineralogical Museum of Berlin, were examined in the hope of finding some additional crystals or grains of quartz but without success. Prof. Rose suggests, however, that particles of quartz may occur amongst the insoluble matters of other iron-meteorites.

Artificial Formation of Crystallized Specular Iron, Magnetic Iron Ore, Magno-ferrite, Periclase, Hausmannite, Cassitirite and Rutile:—These mineral species have been obtained by Saint-Claire Deville in perfectly-formed crystals by the agency of hydrochloric acid gas. By passing a slow current of the gas

over amorphous sesqui-oxide of iron in a heated porcelain tube; crystals of *specular iron ore* resembling in part those of Elba, and partly the flattened volcanic forms, were readily obtained. If the current be sufficiently slow, not a trace of a chloride is produced in this experiment, and the acid consequently is in no way decomposed. The crystals thus formed by M. Deville were capable of being measured. The intervention of aqueous vapour was found to be quite unnecessary, the gas acting perfectly in an absolutely dry condition. Protoxide of iron, as obtained by the process of Debray, yielded under this treatment a number of small octahedrons possessing the exact composition of *magnetic iron ore*. A mixture of sesqui-oxide of iron and calcined magnesia gave, in like manner, octahedrons with truncated edges, having the theoretical composition of pure *magno-ferrite*. Calcined magnesia alone, under a slow current of hydrochloric acid, yielded small octahedral crystals of *periclase*, without the slightest loss or change accruing to the acid itself. *Hausmannite* was also formed in dimetric octahedrons (of 104° to 105° over polar edges) from red oxide of manganese. *Cassiterite*, by the same process, in crystals of great beauty, from amorphous oxide of tin. The crystals were dimetric octahedrons with their basal edges and angles replaced by the two square prisms, these shewing the proper interfacial inclinations of 135°. Finally, amorphous titanic acid furnished minute crystals of a blue colour and great brilliancy, belonging either to Rutile or Anatase, most probably to the former. Deville's experiments are given in detail in several numbers of the *Comptes Rendus* of June and July of the present year. They shed quite a new light on the formation of many crystallized substances in volcanic and other localities, and take rank amongst the most important contributions of the day to chemical geology.

Brucite:—The Brucite of Wood's Mine, Texas, has been described by Hermann, (*Jour. für Prakt. Chem.* lxxxii., p. 368), under the name of *Texalite* as a monoclinic modification of the hydrate of magnesia. This view, however, has been subsequently shewn to be erroneous by Professor George J. Brush of Yale College. Prof. Brush (*American Journal of Science and Arts, July*, 1861), proves clearly the identity of the so-called *Texalite* with *Brucite*, and shews that both are hexagonal.

Staurolite:—The composition of *Staurolite*, as determined more especially by the careful analyses of Jacobson, is well known to vary greatly with regard to the respective amounts of silica and alumina. Rammelsberg has recently undertaken a further examination of this mineral (*Ber. d. Köngl. preuss. Akad. d. Wiss. zu Berlin, März*, 1861), but with the same general results, so far at least as respects its atomic constitution. Analyses of ten examples from various localities shew such different results—the silica varying, for example, from 28·86 to 51·32—that no one common formula can be adopted for all. But Rammelsberg shews, in addition to this, that the iron in the mineral is chiefly present in the state of *protoxide*, whilst all previous analyses had given it as sesqui-oxide. The writer of these notes, however, so long ago as 1848, in a short paper published in the *Chemical Gazette* of July 15 of that year, ("On the Composition of Acmite," &c., by E. J. Chapman), called attention to the fact that by the em-

ployment of a blowpipe-test previously announced by him for distinguishing the protoxide of iron from the peroxide of that metal in silicates and other compounds, he had "discovered the presence of FeO in translucent crystals of Staurolite, a mineral hitherto supposed to be a basic silicate of alumina in which a portion of the Al^2O^3 is replaced by Fe^2O^3." In Rammelsberg's analyses, as in those of Jacobson, the higher the amount of silica the lower that of the alumina, and the reverse. E. J. C.

NOTICES OF PUBLICATIONS RECEIVED.

Descriptions of New Palæozoic Fossils from Illinois and Iowa. By F. B. Meek and A. H. Worthen, Illinois State Geological Survey. In this communication, published in the Proceedings of the Academy of Natural Sciences of Philadelphia, June, 1861, the authors describe various new forms of crinoids and other types from the carboniferous rocks of Illinois and Iowa. Amongst the crinoids they establish a new genus *Bursacrinus*, intermediate apparently between *Ichthyocrinus* and *Cyathocrinus*, its generic formula being: Basals 5?; Sub-radials 5 (four hexagonal and one pentagonal); Radials 2 × 5; Anal 1; Inter-radials 0; Arms 10, bifurcating, but laterally connected. A sub-genus, under the name of *Trematodiscus*, is also proposed for the reception of certain forms of *Nautili* possessing a discoid shell with a wide, shallow, and usually perforated umbilicus. It will include a group of carboniferous species of European as well as of American occurrence.

In a recent notice, contained in the May number of the *Canadian Journal*, we fear we may unintentionally have done some injustice to the very able geologists engaged on the Illinois Survey. In acknowledging a publication forwarded by Prof. Hall, we stated that the descriptions of fossils which this comprised had been issued in order to claim priority for various new species that might probably appear under other names in the forthcoming Report of the Geology of Illinois, since the publication of the concluding portions of the Report on Iowa (under Prof. Hall's direction), had been suspended for a time. In making this remark, we did not for a moment intend to imply that Messrs. Meek and Worthen would intentionally re-describe any published form under another name; but simply that, where several observers were engaged on the same kind of work, coincidences of this sort were more or less unavoidable. We find that a large number of the fossils about to appear in the Illinois Report, were briefly described in the proceedings of the Philadelphia Academy in September and October, 1860; and we understand that every care has been taken, in drawing up this Report, to avoid the introduction of synonymes. The Report itself, with figures and extended descriptions, will be issued during the forthcoming year.

The Primordial Zone of Texas, with Descriptions of New Fossils. By B. F. Shumard. (From the American Journal of Science and Arts, September, 1861). The occurrence of Lower Silurian strata in Texas (subsequently referred by Barrande to the Primordial Zone) was announced by Ferdinand Rœmer in 1852. Prof. Shumard, in 1859, shewed their occurrence over a much more extended

area than had been recognized by Rœmer, and placed them in parallelism with the Potsdam Sandstone and Calciferous Sand Group of Iowa, Wisconsin, and Minnesota. In his present notice, the same author enters into a more detailed analysis of their mineral and other characters, and describes several new Trilobites from the lower or Potsdam Sandstone division.

Contributions to Palæontology. By James Hall. (Fourteenth Annual Report of the Regents of the State Cabinet, Albany; Appendix C, and Continuation, July, August, and September, 1861). Professor Hall, in these issues, continues his descriptions of various new fossils, comprising numerous brachiopods, cephalopods, trilobites, &c., chiefly from the Hudson River Group of Ohio and Tennessee, and from the Devonian Strata of New York. Our restricted space, at present, forbids an analysis of these forms; but we may observe that in the first part of Appendix C, published in July, a description is given of a new *Euomphalus*, named *E. Conradi* by the author. This species appears to be identical with the *Euomphalus de Cewi* of Billings, described and figured in the July number of this Journal. Should this apparent identity prove true, we think that Mr. Billings may fairly claim the species, since that number of the Journal was published on the 9th of July, and copies of Mr. Billings' paper were previously transmitted to him. Even if the dates prove coincident, the description of the species in the Journal must be looked upon as the more complete and satisfactory of the two, as it is illustrated by figures. The Devonian trilobites described in this Appendix by Prof. Hall, belong to the following genera: Calymene, (1 species), Dalmania, (14 species), Phacops, (3 species), Proetus, (15 species), Lichas, (2 species), Acidaspis, (fragmentary examples), and Beyrichia, (1 species).

The Gold of Nova Scotia. By A. C. Marsh, A. B. (From the Am. Journ. of Science and Arts, Nov. 1861.) This is an interesting account of the newly-discovered gold districts of Tangier and Lunenburg. The gold lies chiefly in quartz veins traversing disturbed strata of clay-slate. It is accompanied by mispickel and iron pyrites, the latter, according to Mr. Marsh, being more or less auriferous.* The author also observed three crystallized specimens of gold from the Tangier locality, two of which were octahedrons, and the other a rhombic dodecahedron, with bevelled edges. An analysis of the Tangier gold (sp. gr. 18·95) gave Mr. Marsh: gold 98·18; silver 7·76; copper 0·5; iron, a trace. A sample from Lunenburg (sp. gr. 18·37) consisted of: gold 92·04; silver 7·76; copper 0·11; with also a trace of iron. These gold-containing metamorphic rocks of Nova Scotia are referred by Professor Dawson, (Acadian Geology: Supplement) to the base of the Lower Silurian series. The gold appears to extend over a wide area, since indications of it are said to have been found in the sands of Sable Island, at a distance of one hundred miles or more from the main land.

The Canadian Naturalist and Geologist: (Vol. VI. No. 5.) Oct. 1861. This Number of the Naturalist is an exceedingly interesting one. In addition to sundry miscellaneous notices, it contains original papers by G. Barnston, E. Billings, H. G. Venner, Dr. Dawson, T. Sterry Hunt, and D. W. Beadle. The geological contributions comprise an article on the occurrence of Graptolites in

* This we have verified in specimens obtained from Tangier, and kindly presented to us by Mr. Hawkins, P.L.S., of Toronto.—E. J. C.

the base of the Lower Silurian series by Mr. Billings, and an analysis by Prof. Sterry Hunt of Barrande's recent Review of the Primordial Zone of North America. Dr. Dawson contributes some Additional Notes on Aboriginal Antiquities found at Montreal.

On the Dimorphism of Arsenic, Antimony, and Zinc. By Josiah P. Cooke, Jr. (From the Amer. Journ. March, 1861.) Both Arsenic and Antimony as occurring in nature, and as commonly obtained in the reguline state, are well known to crystallize in rhombohedral or hemi-hexagonal forms. Zinc, as artificially produced, has been generally referred to the Hexagonal, or to the Trimetric system. The experiments of Professor Cooke as detailed in this memoir, seem to prove conclusively, however, that these metals may be also made to assume a monometric crystallization. Arsenic and Antimony were crystallized by sublimation in a current of hydrogen gas. They gave minute octahedrons, combined at times, in the case of the antimony crystals, with the faces of the cube, and in one instance, with those of the rhombic dodecahedron. These modifications do away with all suspicion that the minute crystals may have consisted of rhombohedrons with truncated polar angles. The crystals were moreover carefully examined in order to prove that they did not consist of partially-reduced arsenious acid on the one hand, and of oxide of antimony on the other. The oxidation of the metals would scarcely have taken place however, as these experiments were conducted. Zinc in combination with variable amounts of copper has been shewn by Storer to crystallize in regular octahedrons, and Professor Cooke describes some octahedral crystals of zinc and arsenic, in which the latter metal was in too small a proportion to form a definite chemical compound. The heteromorphous character of these metals appears therefore to be fairly established. E. J. C.

MISCELLANEOUS.

ON CLEANING AND PREPARING DIATOMS, ETC., OBTAINED FROM SOUNDINGS. BY J. B DANCER.

The first operation generally required is to separate the soundings from the tallow or fatty matter which has been employed to bring them up from the bottom. I may here mention that Lieutenant Stellwagen, an American officer, has invented a sounding-lead which does not require grease. It has a trap at the bottom for collecting the soundings. I am sure our section will join with me in the wish that the soundings which our worthy Secretary hopes to receive from various parts of the world may be collected with an apparatus of this kind. The grease involves a considerable amount of trouble, and some loss. The mass of soundings and grease is to be placed in a basin or an evaporating-dish, and boiling water poured on it; the melted fat rises to the surface, and when cold can be easily skimmed off. This operation may be repeated until the sediment appears free from grease; to insure this, draw the water carefully from the sediment, and pour liquor ammonia on it; I prefer it to potass or soda; this will combine with the grease, if any remain, and form a soapy solution. This may now be treated with hot water for the final washing. This sediment must be allowed to settle quietly for an hour or two each time before the water is carefully

decanted or drawn off with a syphon; otherwise the minute forms of Diatomaceæ will be lost, and the operator greatly disappointed in the result of his labour. Having now cleared the soundings from all extraneous matter, the next operation is to ascertain, by the microscope, the nature of the objects thus obtained. Take up with a glass tube some of the sediments, draw the contents of the tube along a slip of glass, and examine it with a low power. If Foraminiferæ or large Diatomaceæ are present, they may be removed by means of a split hair or a bristle from a shaving-brush, gummed or fixed in a cleft in a split of wood, and then placed on a clean slip of glass for further examination. If you have a considerable quantity of mud or sand under the operation, with an abundance of Foraminiferæ, as is frequently the case, they can be separated by first drying the soundings, and scattering them on the surface of water in a basin; the heavy particles of sand will sink, but the light Foraminiferæ will float for a time, and can be easily collected. Another mode is to stir up the sediment, and then pour off the lighter articles into test-tubes or wine glasses. In this manner, by having a number of glasses, you can separate the varieties according to their specific gravities. If the Diatomaceæ obtained are recent and abundant, they should be separated from the calcareous portions of the soundings, and boiled in hydrochloric acid; and if not sufficiently cleaned, they may be boiled in nitric acid. The contents of the diatoms can be removed by burning them. Place them between two thin pieces of talc, and submit them to the flame of a spirit-lamp. Some use thin glass to support them when cleaning a quantity. I have burnt them in a small platinum crucible with success. It is advisable to mount specimens dry, and also in balsam, for careful microscopic examination. Those mounted dry show the markings most distinctly. There is one difficulty which the slide-mounter meets with on his first essay, and which I will briefly allude to, viz., retaining the object in its proper place on the slide whilst the thin glass is being pressed down on the balsam. Some operators place the thin glass on the objects, and allow the balsam to flow gradually between the glasses by capillary attraction. Professor Williamson employs a little gum' in the water which contains the Diatomaceæ; this fixes them when dry, and the balsam does not remove them. Some objects, such as Foraminiferæ, require a long soaking in spirits of turpentine to displace the air from the chambers. By using an air-pump this process is much facilitated. A solution of balsam in chloroform will doubtless be an improvement in mounting this class of objects. It is needless to take up the time of the section by entering minutely into the details of mounting all the various objects which may be met with in specimens of soundings. Those interested may consult Quekett, Carpenter, and Hogg's works on the microscope; and Smith on Diatomaceæ. I must now apologise for taking up so much time on a subject which many present may be conversant with.

P.S.—Since the above was written, several engravings, with descriptions have appeared in the 'Mechanics' Magazine,' December 28, 1860, of the deep-sea-sounding apparatus invented and used on board *The Bull Dog* during the sounding expedition in the North Atlantic Ocean, under the command of Sir F. L. M Clintock, with one of these machines. Twenty-four ounces of ooze was brought up from a depth of 1,913 fathoms.—*Journal of the Microscopical Society.*

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—AUGUST 1861.

Latitude—43 deg. 39.4 min. North. Longitude—5 h. 17 min. 33 sec. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp of the Air.				Excess of mean above Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M	2 P.M	10PM	ME'N		6 A.M	2 P.M	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M	2 P.M	10PM	Resul't.	ME'N		
1	29.553	29.561	29.535	29.5525	°68.4	°78.2	°66.3	°71.63	+ °4.67	.604	.686	.620	.641	.87	.71	.95	.83	N b E	S S E	Calm.	S °55 E	7.5	5.5	0.0	1.41	2.23	...	...
2	.533	.456	.438	.4735	65.2	78.2	71.0	72.05	+ 5.20	.510	.718	.700	.649	.82	.74	.92	.82	Calm.	S E b E	N E b N	N 72 E	0.0	7.5	1.2	1.70	4.37	..	...
3	.553	.617	.621	.6030	72.0	78.9	70.2	74.20	+ 7.35	.672	.646	.651	650	.86	.65	.88	.78	N	S S E	N E b E	N 84 E	11.4	7.5	3.2	3.92	6.07	...	...
4	.546	.407	—	—	69.2	82.5	—	—	—	.607	.793	—	—	.86	.71	—	—	N E b E	S b W	W	S 37 W	4.2	6.2	7.5	3.58	5.80	0.005	...
5	.464	.486	.504	.4840	71.7	80.3	67.7	73.17	+ 6.37	.630	.755	.502	.646	.81	.73	.75	.78	N W b N	S b E	W	N 84 W	1.5	4.6	2.8	0.87	3.26	...	...
6	.535	.535	.609	.5620	63.0	74.2	66.6	68.92	+ 2.15	.450	.628	.545	.560	.78	.75	.83	.78	Calm.	S E	Calm.	S 80 E	0.0	5.0	0.0	1.25	1.84	0.013	...
7	.613	.625	.632	.6232	63.0	64.1	61.9	62.65	— 4.03	.487	.565	.503	.516	.85	.94	.90	.90	E N E	E N E	N E	N 56 E	3.6	7.3	4.0	4.78	4.95	0.465	...
8	.621	.627	.595	.6117	61.9	68.4	64.8	65.18	— 1.48	.428	.481	.489	.476	.77	.69	.80	.77	N E	E b N	N E b N	N 74 E	4.0	8.2	1.0	4.28	4.47	0.115	...
9	.522	.503	.450	.4885	65.5	68.1	63.4	66.57	+ 0.02	586	.594	.548	.580	.93	.87	.93	.89	E b N	E N E	W b N	N 68 E	7.0	4.0	2.5	1.91	3.29	0.015	...
10	.431	.383	471	.4343	60.9	77.8	66.6	69.15	+ 2.63	.414	.676	.441	.525	.78	.71	.67	.72	Calm.	S S W	N b W	N 29 W	0.0	12.0	4.0	2.84	6.87	...	...
11	.601	.602	—	—	57.2	67.0	—	—	—	.337	.375	—	—	.71	.55	—	—	N b E	S S E	N N E	N 88 E	1.0	3.5	1.0	1.59	2.58	...	...
12	.582	.592	.588	.5900	60.5	58.0	55.8	57.92	— 8.43	.360	.416	.422	.398	.69	.86	.95	.84	N E	N E	N E b N	N 43 E	2.0	9.6	14.0	9.92	10.01	0.760	...
13	.589	.673	.770	6892	56.5	68.1	58.3	60.77	— 5.47	.378	.524	.367	.425	.83	.77	.75	.80	N E b N	E	Calm.	N 54 E	12.0	4.6	0.0	4.05	5.09	...	...
14	.840	.857	.858	.8513	55.4	68.4	54.0	59.40	— 6.83	.316	.428	.335	.366	.72	.61	.80	.72	N b W	S S W	Calm.	S 7 W	1.2	2.8	0.0	0.91	1.39	...	...
15	.887	.875	.790	.8415	48.2	71.0	58.7	61.35	— 4.80	.287	.484	.373	.391	.85	.64	.75	.72	Calm.	S	Calm.	S 25 E	0.0	3.0	0.0	0.68	1.02	...	...
16	.760	.707	.713	.7272	55.8	72.0	62.7	64.70	— 1.50	.400	.486	.426	.450	.90	.62	.75	.74	Calm.	S E b S	S W b S	S 6 E	0.0	8.2	1.0	2.93	3.21	..	...
17	.713	.698	.747	.7213	58.3	73.8	65.2	66.18	+ 0.22	.412	.633	.445	.507	.85	.77	.71	.78	Calm.	S E b S	N b W	S 85 W	0.0	2.5	0.5	0 36	1.88	Inp.	...
18	.803	.778	—	—	54.4	75.3	—	—	—	.330	.662	—	—	.78	.76	—	—	N W	S	N	S 80 W	2.2	7.6	1.0	0.12	2.58	Inp.	...
19	.798	.784	.794	.7905	59.8	68.1	61.9	64.13	— 1.63	.428	.511	.477	.469	.83	.75	.86	.78	N N E	E	Calm.	N 78 E	1.5	5.5	0.0	2.17	2.60	...	...
20	.853	.862	.841	.8545	60.9	68.8	61.2	64.23	— 1.3	.426	.410	.446	.424	.80	.58	.83	.71	N E b E	E	Calm	S 89 E	2.0	8.6	0.0	3.19	3.24	...	...
21	.766	.618	.511	.6202	61.6	78.2	70.6	70.48	+ 5.05	.481	.717	.653	.621	.87	.74	.88	.83	Calm.	S b W	S W b S	S 49 W	0.0	13.5	5.0	3.86	7.08	0.575	...
22	.458	.546	.664	.5710	61.6	68.4	56.2	61.70	— 3.65	.507	.575	.328	.451	.92	.83	.72	.81	N W	N W	N W	[illegible]	[illegible]	[illegible]	[illegible]	9.73	9.92	...	...
23	.750	.718	.753	.7407	52.6	73.8	59.8	63.15	— 1.98	.342	.382	.392	.371	.86	.46	.76	.66	N W	W N W	W N W	N 75 W	[illegible]	[illegible]	[illegible]	4.45	5.21		...
24	.779	.774	.803	.7882	52.6	73.8	65.5	65.18	+ 0.23	.353	.517	.493	.455	.89	.62	.78	.74	Calm.	S b W	N	S 41 W	0.0	6.6	3.6	0.88	1.85	...	...
25	.835	.790	—	—	56.9	73.1	—	—	—	.396	.527	—	—	.85	.64	—	—	Calm.	S E	E b S	S 50 E	0.0	3.0	1.0	1.10	1.60	0.115	...
26	.733	.685	.673	.6987	64.5	74.6	65.2	67.92	+ 3.38	.507	.579	.550	.560	.83	.67	.88	.82	E b S	S W b W	Calm.	S 21 W	0.8	2.0	0.0	1.82	1.98	0.605	...
27	.659	.621	.639	.6312	65.2	74.6	63.4	68.03	+ 3.72	.563	.607	.521	.557	.90	.71	.89	.81	S S W	S S W	W b S	S 29 W	8.5	12.5	5.8	6.32	7.00	0.085	...
28	.662	.620	.631	.6312	60.1	69.9	64.1	66.07	+ 1.93	.476	.670	.499	.545	.92	.92	.83	.85	Calm.	S b E	N W b N	S 23 W	0.0	4.4	0.5	1.87	2.33	0.165	...
29	.628	.565	.617	.6067	62.3	71.0	57.6	63.27	— 0.55	.471	.528	.410	.473	.84	.69	.86	.81	Calm	S b W	Calm.	N 75 W	0.0	0.5	0.0	1.20	2.38	0.035	...
30	.636	.619	.701	.6592	54.4	69.3	56.2	60.45	— 3.17	362	.372	.275	.354	.86	.50	.60	.67	W N W	N W b W	N W	N 49 W	7.6	13.3	9.5	10.71	10.92	...	...
31	.755	.784	.779	.7840	51.1	66.6	57.2	59.40	— 3.92	.289	.313	.324	.315	.76	.48	.69	.63	N N W	S S W	N N E	N 31 W	1.5	6.0	2.0	1.85	3.54	...	...
M	29.6346	29.6441	29.6506	29.6530	60.48	71.75	62.67	65.48	— 0.28	.450	.552	.472	.495	.84	.70	.81	.78	....	....	....	....	3.10	6.73	2.64	......	4.21	2.953	...

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR AUGUST, 1861.

Highest Barometer........................ 29.902 at 8 a. m. on 15th } Monthly range =
Lowest Barometer ... . 29.382 at 4 p. m. on 10th } 0.520 inches.

Self-registering Thermom.
- Maximum Temperature .... 85°2 on p.m. of 4th } Monthly range =
- Minimum Temperature .... 47°0 on a.m. of 15th } 38°2
- Mean maximum Temperature .... 74°30 } Mean daily range =
- Mean minimum Temperature .... 58°15 } 16°16
- Greatest daily range .... 25°0 from a. m. to p. m. of 15th.
- Least daily range.................. 4°6 from a. m. to p. m. of 7th.

Warmest day......... 3rd... Mean temperature......... 74.20 } Difference = 16°28.
Coldest day......... .. 12th... Mean temperature......... 57°92 }
Maximum Radiation. { Solar.................................. 101°8 on p. m of 2nd } Monthly range =
{ Terrestrial......................... 39°0 on a. m. of 15th } 62°8
Aurora observed on 4 nights, viz.: 1st, 2nd, 14th and 22nd.
Possible to see Aurora on 17 nights; impossible on 14 nights.
Raining on 15 days,—depth 2.953 inches; duration of fall 43.3 hours.
Mean of cloudiness = 0.54. Above average .09.
Most cloudy hour observed, 4 p. m., mean = 0.64; least cloudy hour observed do. midnight; mean, = 0.42.

Sums of the components of the Atmospheric Current, expressed in miles.

North.	South.	East.	West.
1240.81	903.18	983.30	938.11

Resultant direction N. 8° E.; Resultant velocity 0.46 miles per hour.
Mean velocity........................... 4.21 miles per hour.
Maximum velocity .... 21.7 miles, from 10 to 11 a. m. on 30th.
Most windy day ....30th......... Mean velocity, 10.92 miles per hour. } Difference =
Least windy day.........15th......... Mean velocity 1.02 ditto. } 9.90 miles.
Most windy hour......1 to 2 p.m. ....Mean velocity 6.92 ditto. } Difference =
Least windy hour......2 to 3 a.m. ....Mean velocity 2.32 ditto. } 4.60 miles.

1st. Dense Fog 8 to 11 p.m. Sheet Lightning in N.W. at midnight.
2nd. Sheet Lightning round horizon from 6 p.m. to midnight.
3rd. Shooting Stars numerous at night.
4th. Thunderstorm, Lightning and Rain from 9 p.m.
5th. Dense Fog 6 to 7 p.m. Sheet Lightning at midnight.
9th. Shooting Stars numerous at night. Dense Fog from 10.30 p.m.
20th. Well defined Solar Halo at 2 p.m.
21st. Perfect Solar Halo at 7.30 a.m. Thunderstorm, Lightning and heavy Rain, 9 p.m. to 1 a.m. of 22nd.
23rd. Lunar Corona from 10 p.m. to midnight.
25th. Very perfect Solar Halo during the forenoon.
26th. Sheet Lightning in N.W. at 10 p.m.
27th. Thunderstorm, Lightning and Rain, from 8.30 to 11.50 p. m.
28th. Sheet Lightning in W. and S.W., from 7 p.m.
29th. Thunderstorm from 3.35 to 4 p.m. Rainbow at 4.10 p.m.

Heavy Dew recorded on 14 mornings during the month.
The Resultant Direction and Velocity of the Wind for the month of August, from 1848 to 1861 inclusive, were respectively N. 58 W. and 0.85 miles.

COMPARATIVE TABLE FOR AUGUST.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	No. of days.	Inch's.	No. of days.	Inch's.	Resultant Direction.	Resultant V'y	Mean Force or Velocity.
1840	64.7°	—1.3°	80.1°	47.4°	32.7°	12	2.90?	...	...	...	...	....
1841	64.4	—1.6	83.5	46.7	36.8	9	6.170	...	...	...	...	0.19 lbs.
1842	65.7	—0.3	80.7	45.3	35.	6	2.500	...	...	...	...	0.30
1843	66.4	+0.4	85.5	44.4	41.1	4	4.850	...	...	...	...	0.12
1844	64.3	—1.7	82.5	44.3	38.2	17	Imp.	...	...	...	...	0.16
1845	67.9	+1.9	82.5	44.4	38.1	9	1.725	...	...	...	...	0.19
1846	68.4	+2.4	86.3	50.4	35.9	9	1.770	...	...	...	...	0.17
1847	65.1	—0.9	83.1	44.9	38.2	10	2.140	...	...	...	...	0.19
1848	69.2	+3.2	87.5	49.3	38.2	8	0.855	...	...	S 21° E	0.98	4.55mls.
1849	66.3	+0.3	79.5	51.4	28.1	10	4.970	...	...	N 71° W	0.60	3.76
1850	66.8	+0.8	84.2	43.0	41.2	13	4.355	...	...	N 15° E	0.35	4.46
1851	63.6	—2.4	79.8	43.6	36.2	10	1.360	...	...	N 63° W	0.40	4.63
1852	65.9	—0.1	81.2	46.7	34.5	9	2.095	...	...	N 70° W	0.56	3.30
1853	68.6	+2.6	91.6	47.6	44.0	11	2.575	...	...	S 36° E	0.30	4.26
1854	68.0	+2.0	98.1	47.0	51.1	5	0.455	...	...	N 64° W	1.76	4.60
1855	64.1	—1.9	82.1	44.9	37.2	7	1.455	...	...	N 63° W	1.04	6.97
1856	63.6	—2.4	81.3	44.0	37.3	12	1.680	...	...	N 50° W	2.88	7.03
1857	65.3	—0.7	85.3	50.1	35.2	13	5.265	...	...	N 77° W	1.51	6.36
1858	67.6	+1.6	83.4	45.4	38.0	11	3.890	...	...	N 69° W	1.57	6.50
1859	66.6	+0.6	81.4	46.2	35.2	11	3.990	...	...	N 36° W	1.62	5.96
1860	64.5	—1.5	81.8	47.1	34.7	14	3.405	...	...	N 70° W	1.83	5.80
1861	65.5	—0.5	82.5	48.2	34.3	15	2.933	...	...	N 8° E	0.46	4.21
M	66.02	...	83.81	46.47	37.35	10.2	2.951	...	...	....	...	5.17 Ml.
Diff. from av'e.	— 0.54	...	— 1.31	+ 1.73	— 3.05	+ 4.8	+ 0.002	...	...	....	...	— 0.96

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—SEPTEMBER, 1861.

Latitude—43 deg. 39.4 min. North. Longitude—5 h. 17 m. 33 s. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°. 6 A.M.	2 P.M.	10 P.M.	Mean.	Temp. of the Air. 6 A.M	2 P.M	10 P.M	ME'N	Excess of mean above Average	Tens. of Vapour. 6 A.M	2 P.M.	10 P.M.	M'N
					°	°	°	°	°				
1	29.846	29.781	—	—	54.0	67.0	—	—	—	.335	.409	—	—
2	.685	.582	.492	.5660	62.3	76.0	69.2	69.83	+ 7.10	.484	.665	.593	.588
3	.559	.545	.702	.6110	62.7	78.2	61.2	66.77	+ 4.33	.492	.624	.317	.472
4	.797	.827	.799	.8040	54.3	64.5	55.8	58.55	— 3.58	.344	.354	.355	.346
5	.714	.608	.481	.5885	50.4	67.7	63.4	61.28	— 0.55	.330	.399	.483	.415
6	.355	.344	.524	.4182	59.4	73.8	57.3	63.87	+ 2.43	.446	.463	.346	.410
7	.682	.763	.886	.7878	50.8	60.9	54.0	55.47	— 5.68	.307	.355	.313	.327
8	.943	.932	—	—	47.2	61.6	—	—	—	.249	.333	—	—
9	.962	.959	.935	.9483	54.9	61.6	54.7	57.63	— 2.72	.367	.428	.325	.366
10	.935	.843	.642	.7825	53.6	63.4	61.2	59.58	— 0.47	.340	.431	.474	.417
11	.370	.383	.472	.4075	62.7	61.9	59.4	61.17	+ 1.52	.543	.503	.446	.491
12	.509	.544	.602	.5602	58.0	68.4	54.4	60.73	+ 1.50	.423	.349	.361	.382
13	.678	.658	.713	.6833	51.8	72.2	63.7	63.33	+ 4.48	.332	.497	.465	.444
14	.676	.574	.575	.6083	61.9	65.9	66.3	65.07	+ 6.73	.489	.581	.603	.561
15	.657	.673	—	—	59.8	74.2	—	—	—	.452	.540	—	—
16	.843	.769	.669	.7470	50.0	60.9	55.5	56.33	— 1.18	.304	.321	.347	.332
17	.569	.549	.592	.5713	54.7	62.3	50.8	55.93	— 1.07	.325	.325	.335	.328
18	.599	.571	.534	.5665	51.1	67.4	58.3	60.43	+ 3.82	.352	.442	.412	.421
19	.501	.412	.538	.4862	56.5	72.0	68.8	66.93	+10.82	.413	.627	.263	.459
20	.554	.522	.354	.4665	58.3	60.1	56.2	57.73	+ 2.13	.390	.448	.417	.421
21	.392	.527	.634	.5287	51.5	53.3	51.1	52.03	— 3.08	.357	.291	.330	.327
22	.624	.516	—	—	39.2	59.8	—	—	—	.223	.381	—	—
23	.495	.528	.648	.5675	50.4	65.5	50.8	56.03	+ 1.82	.330	.480	.283	.361
24	.736	.734	.700	.7252	45.5	63.4	52.6	55.00	+ 1.25	.262	.363	.332	.324
25	.685	.604	.533	.6032	48.6	68.4	62.3	61.15	+ 7.92	.322	.448	.484	.433
26	.442	.327	.377	.3783	61.6	69.9	55.8	62.72	+ 9.98	.493	.556	.377	.473
27	.362	.259	.097	.2307	55.5	53.3	49.0	52.53	+ 0.32	.369	.377	.307	.348
28	.252	.432	.706	.4880	47.2	52.9	41.7	47.58	— 4.25	.287	.274	.228	.263
29	.888	.951	—	—	37.1	52.9	—	—	—	.182	.274	—	—
30	30.089	30.076	30.087	30.0847	46.8	54.0	46.4	48.95	— 1.87	.293	.292	.278	.281
M	29.6176	29.5972	29.6113	29.6084	54.38	64.72	56.80	59.07	+ 1.58	.376	.436	.379	.400

Day.	Humidity of Air. 6 A.M	2 P.M.	10 P.M.	M'N	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Resul't. Direction.	Velocity of Wind. 6 A.M.	2 P.M.	10 P.M.	Result'.	ME'N	Rain in inches.	Snow in inches.
								°							
1	.80	.61	—	—	N N E	E b S	E b N	S 88 E	4.0	8.3	3.0	4.45	4.70	Inp.	...
2	.86	.74	.83	.81	Calm.	S b E	S W b S	S 41 W	0.0	6.2	13.0	6.98	8.3[illegible]	0.002	...
3	.86	.64	.58	.70	W S W	S W b S	N W	N 64 W	1.0	8.0	15.6	8.08	10.21	0.070	...
4	.84	.58	.80	.71	N N W	N W b W	N	N 30 W	5.4	7.2	5.0	4.2[illegible]	4.47	...	...
5	.90	.58	.82	.77	Calm.	S E	S S W	S 18 E	0.0	6.2	4.6	2.76	3.02	...	...
6	.88	.55	.73	.69	Calm.	W b S	N W b N	N 87 W	0.0	14.2	3.3	6.56	7.2[illegible]	...	...
7	.85	.67	.75	.75	N	N N W	Calm.	N 20 W	1.0	5.3	0.0	2.30	2.88	Inp.	...
8	.76	.61	—	—	N b E	S E b S	Calm.	S 66 E	2.6	7.2	0.0	2.01	2.58	Inp.	...
9	.85	.78	.76	.77	Calm.	Calm.	Calm.	N 17 E	0.0	0.0	0.0	0.90	1.38	Inp.	...
10	.82	.73	.87	.81	N	E b N	E b S	N 80 E	1.0	2.0	4.4	3.98	4.17	0.345	...
11	.95	.90	.88	.90	E b N	N	N N W	N 9 W	9.2	0.8	7.5	2.47	3.55	0.030	...
12	.88	.50	.86	.74	N W b W	W N W	Calm.	N 66 W	5.8	12.2	0.0	2.93	3.12	...	...
13	.86	.62	.78	.75	Calm.	S b W	Calm.	S 18 W	0.0	7.6	0.0	2.74	2.77	...	...
14	.88	.91	.93	.90	S b E	S E b S	W S W	S 41 W	0.6	2.8	4.0	1.23	2.05	0.115	...
15	.88	.63	—	—	Calm.	S b W	N N W	N 27 W	0.0	0.3	0.5	2.55	2.92	...	...
16	.84	.59	.79	.73	N N E	E S E	Calm.	N 78 E	2.8	6.6	0.0	1.87	2.39	...	...
17	.76	.57	.90	.74	N E	E N E	N W b N	N 15 E	1.0	5.4	1.4	3.49	4.29	Inp.	...
18	.94	.65	.85	.81	N	S	S W	S 19 W	7.4	6.8	3.0	4.19	5.85	...	...
19	.91	.80	.37	.69	S W b W	S W b S	N W b N	S 62 W	3.8	8.8	9.8	4.20	7.23	Inp.	...
20	.80	.86	.93	.88	N	E b N	N E b E	N 44 E	5.0	8.8	8.5	7.32	8.29	0.895	...
21	.94	.71	.88	.84	N	N N E	N W b N	N 4 W	6.2	12.0	3.8	8.20	8.44	0.043	...
22	.94	.74	—	—	N N W	S b W	S W b S	S 57 W	4.0	9.5	7.0	4.89	6.74	...	...
23	.90	.76	.76	.79	W N W	W	Calm.	N 67 W	5.8	10.3	0.0	8.01	8.21	...	...
24	.86	.62	.84	.76	N W	S	S S W	S 1 W	2.4	3.5	0.7	1.25	1.94	...	...
25	.94	.65	.86	.81	Calm.	S S E	E	S 25 E	0.0	5.0	1.0	1.99	2.17	...	...
26	.90	.76	.85	.82	S b E	S W b S	Calm.	S 36 W	3.5	14.0	0.0	3.88	5.13	0.175	...
27	.84	.92	.88	.88	Calm.	N	N W b W	N 44 W	0.0	5.0	13.0	5.07	7.[illegible]6	1.855	...
28	.89	.69	.86	.80	W S W	W	W b N	S 85 W	3.0	18.5	0.6	7.48	7.75	0.020	...
29	.83	.69	—	—	Calm.	S S W	Calm.	S 82 W	0.0	5.0	0.0	2.76	3.29	0.057	...
30	.91	.69	.88	.81	Calm.	S S E	N b E	N 46 E	0.0	3.0	3.0	1.18	2.03	...	...
M	.87	.70	.81	.79	....	....	....	....	2.52	7.02	3.76	......	4.81	3.607	......

Highest Barometer	30.104 at 8 a. m. on 30th.	Monthly range= 1.028 inches.	
Lowest Barometer	29.076 at 8 p. m. on 27th.		
Self-registering Ther.	Maximum temperature	78°8 on p.m. of 3rd	Monthly range= 41°7
	Minimum temperature	37°1 on a.m. of 29th	
	Mean maximum temperature	66°38	Mean daily range=14°58
	Mean minimum temperature	51°80	
	Greatest daily range	24°0 from a. m. to p. m. on 13th.	
	Least daily range	4.6 from a. m. to p. m. on 21st.	

Warmest day . . 2nd ... Mean Temperature . . . =69°83 } Difference=22°25.
Coldest day . . . 28th ... Mean Temperature . . . =47°58 }

Maximum { Solar . . . . 96°4 on p. m of 3rd } Monthly range=
Radiation { Terrestrial . . . . 29°5 on a. m. of 29th } 66°9.

Aurora observed on 4 nights, viz.: on 2nd, 4th, 5th, and 15th. Possible to see Aurora on 16 nights; impossible on 14 nights.
Snowing on — day: depth, — inches; duration of fall, — hours.
Raining on 17 days; depth, 3.607 inches; duration of fall, 60.1 hours.
Mean of cloudiness=0.60; above the average 0.11 Most cloudy hour observed 2 p.m.; mean =0.72; least cloudy hour observed, midnight; mean=0.50.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
1265.27	837.58	590.28	1537.60

Resultant direction, N 71° W; Resultant Velocity, 1.39 miles per hour.
Mean velocity 4.81 miles per hour.
Maximum velocity 19.8 miles, from 3 to 4 p.m. on the 28th.
Most windy day 3rd—Mean velocity 10.21 miles per hour. } Difference 8.83 miles.
Least windy day 9th—Mean velocity 1.38 miles per hour. }
Most windy hour, noon to 1 p. m.—Mean velocity, 7.65 miles per hour. } Difference
Least windy hour, 5 to 6 p. m. —Mean velocity, 2.42 miles per hour. } 5.23 miles.

2nd. Slight thunderstorm, 4 to 5 p.m., and sheet lightning at midnight.—13th. Lunar halo, 8 to 10 p.m.—15th. Zodiacal light very bright from 7 p.m.—16th. Solar halo at 6.15 a.m.—19th. Solar halo at 7.30 a.m.—20th. Thunderstorm at 6.20 to 8 a.m., and sheet lightning at 7 p.m. to midnight.—22nd. Hoar frost at 5.50 a.m. (First of the season.)—24th. Lunar corona at midnight.—25th. Imperfect rainbow at 4 p.m.—29th. Thin ice on shallow vessels. (First of the season.)

Heavy dew recorded on 10 mornings during the month.

The Resultant Direction and Velocity of the Wind for the month of September, from 1848 to 1861 inclusive, were respectively N. 62° W., and 1.13 miles.

From an inspection of the Comparative Table, it will be seen that the Month of September, 1861, was comparatively warm, dry, calm, and cloudy.

COMPARATIVE TABLE FOR SEPTEMBER.

	TEMPERATURE.					RAIN.		SNOW.		WIND.		
YEAR.	Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	No. of days.	Inches.	No. of days.	Inches.	Resultant. Direction.	Resultant. Velocity.	Mean Velocity
1840	54.0	− 3.9	70.2	29.4	40.8	4	1.380	...	...	...	...	...
1841	61.3	+ 3.4	79.9	37.5	42.4	9	3.340	...	...	...	...	0.26lbs
1842	55.7	− 2.2	83.5	28.3	55.2	12	6 160	...	...	...	...	0.45 "
1843	59.1	+ 1.2	87.8	33.1	54.7	10	9.760	...	...	...	...	0.57 "
1844	58.6	+ 0.7	81.5	29.6	51.9	4	Imp	...	...	...	...	0.26 "
1845	56.0	− 1.9	78.8	35.3	43.5	16	6.245	...	...	...	...	0.34 "
1846	63.6	+ 5.7	84.0	39.0	45.0	11	4.595	...	...	...	...	0.33 "
1847	55.6	− 2.3	74.8	38.1	36.7	15	6.665	...	...	...	...	0.33 "
1848	54.2	− 3.7	80.9	29.5	51.4	11	3.115	...	...	N 71 W	2.38	5.81ms.
1849	58.2	+ 0.3	80.6	33.5	47.1	9	1.480	...	...	N 75 W	0.69	4.23 "
1850	56.5	− 1.4	76.0	31.7	44.3	11	1.735	...	...	S 65 W	1.02	4.78 "
1851	60.0	+ 2.1	86.3	33.4	52.9	9	2.665	...	...	N 14 E	1.03	5.45 "
1852	57.5	− 0.4	81.8	36.1	45.7	10	3.630	...	...	N 77 W	0.53	4.60 "
1853	58.8	+ 0 9	85.4	36.1	49.3	12	5.140	...	...	N	1 06	4.33 "
1854	61 0	+ 3.1	93.1	36.3	56.8	14	5.375	...	...	N 22 W	1.33	4.04 "
1855	59.5	+ 1.6	81.7	36.1	45.6	12	5.585	...	...	N 20 E	1.29	7.61 "
1856	57.1	− 0.8	77 3	37.4	39.9	13	4.105	...	...	S 79 W	1.98	6.53 "
1857	58.6	+ 0.7	81.4	34.1	47.3	11	2.640	...	...	N 68 W	1.61	5.55 "
1858	59.1	+ 1.2	80.1	36.8	43.3	8	0.735	...	...	S 74 W	1.53	5.69 "
1859	55.2	− 2.7	73 8	35.7	38.1	15	3.525	...	...	N 44 W	1.60	6.36 "
1860	55.3	− 2.6	74.2	28.7	45.5	14	1.959	...	...	N 71 W	2.63	5.79 "
1861	59.1	+ 1.2	78.2	37.1	41.1	17	3.607	...	...	N 71 W	1.39	4.81 "
Mean	57.91	...	80.51	34.22	46.30	11.2	3.973	...	...	...	...	5 40
Diff. from Av'ge.	+1.16	...	−2.31	−2.88	−5.20	+5.8	−.366	...	...	...	...	−0.59

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—AUGUST, 1861.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M.D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.—F.			Tension of Vapour.			Humidity of Air.			Direction of Wind.			Horizontal Movement in Miles in 24 hours.	Mean of Ozone. t'nths	Rain in inches	Snow in inches.	Weather, &c. A Cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A. M.	2 P. M.	10 P. M.	6 A. M.	2 P. M.	10 P. M.	6 A.M.	2 P.M.	10 P.M	6 A.M.	2 P.M.	10 P.M	6 A. M.	2 P. M.	10 P. M					6 A. M.	2 P. M.	10 P. M.
1	29.788	29.729	29.720	67.4	89.6	70.1	.584	.835	.586	.87	.62	.80	E s E	E s E	E s E	5.60	2.0	...	...	C. C. Str. 4.	Clear.	Clear. Ft.A.B.
2	723	649	543	70.0	84.7	72.2	621	870	706	85	73	90	s E	s b E	N W	31.40	1.5	Inap.	...	Fog.	C. C. Str. 10.	Cirr. Str. 10.
3	709	753	837	71.4	85.1	68.3	592	570	509	83	47	75	W	W	W s W	87.00	1.5	...	...	Clear.	Clear.	Clear.
4	786	608	514	65.2	85.7	73.5	516	768	712	84	63	83	s E b E	s s E	s s W	58.10	2.0	Inap.	...	Do.	C. C. Str. 8.	Cu. Str. 4. Th.
5	545	614	651	68.1	84.1	64.6	483	789	528	72	68	86	W N W	W	W	175.00	2.0	0.310	...	Cu. St. 10.	Clear.	C. C. Str. 8.
6	710	705	837	60.5	68.3	57.7	419	349	378	80	51	81	W	W N W	N b W	119.80	1.6	...	...	Clear.	Str. 4.	Cu. Str. 4.
7	854	819	890	59.7	78.5	64.6	345	619	497	68	64	83	s	s w b s	s	56.40	1.5	...	...	Do.	Clear.	Str. 4.
8	869	799	826	61.6	76.6	61.1	383	497	419	71	59	80	E b N	N N E	s s E	60.80	1.0	...	...	Do.	Do.	Clear. Au. Bo.
9	784	701	741	60 1	83.0	61.4	396	558	415	76	50	77	E b N	s b E	s b E	11.00	1.0	...	...	Do.	Cirr. 2.	C. C. Str. 4.
10	488	420	548	68.5	83.6	61.0	577	711	360	85	62	68	W s W	s W	s E b E	160.40	1.5	0.290	...	C. C. Str. 4.	Cu Str. 6.	Cl'r. Dist. th.
11	698	809	816	52.1	78.2	58.5	334	704	387	86	73	79	W s W	s	W N W	48.70	1.5	...	...	Clear.	Clear.	Clear. Au. Bo.
12	897	823	860	53.2	73.4	59.4	305	476	380	79	59	76	N E b N	s s E	N N E	78.10	1.5	...	...	Cu. Str. 4.	C. C. Str. 8.	Cu. Str. 9.
13	891	913	939	54.6	71.0	59.4	301	316	323	71	42	65	N N E	N E b E	N E b E	229.30	2.0	...	...	Do. 6.	Cu. Str. 4.	Do. 4. In.ft.H.
14	990	999	30.060	53.5	71.1	51.0	295	386	252	73	53	68	N E b E	s s W	s s W	224.40	2.0	...	...	Do. 10.	Do.	Clear. Au. Bo.
15	30.001	30.089	026	49.7	80.2	62.4	315	452	429	89	44	77	s s W	s s W	s s W	50.30	1.5	...	...	Cl'r. H'y dew.	Do.	Do.
16	29.995	29.941	29.975	58.0	84.3	66.6	400	558	496	84	50	77	s	s s W	s s W	45.60	1.5	...	...	Clear.	Clear.	Cu. Str. 10.
17	896	846	30.004	64.2	78.8	66.0	409	514	509	70	54	81	s W	W s W	s W	90.60	1.5	Inap.	...	Cu. Str. 4.	C. C. Str. 8.	Do. 10.
18	894	999	29 951	64.1	79.6	65.0	373	465	513	62	47	86	N	W	W N W	57.50	1.5	...	...	Cirr. 4.	Cu. Str. 4.	Do. 10.
19	30.017	999	30.056	58.1	83.1	60.2	288	637	426	61	56	62	N E b E	N E b E	E b s	61.10	1.0	...	...	Clear.	Clear.	Cu. Str. 4.
20	082	30.190	151	50.0	76.0	56.6	318	376	363	74	42	81	N N E	E s E	E b N	155 50	1.0	...	...	Do.	Cirr. 4.	Clear.
21	070	045	29.897	56.0	69.3	65.1	363	564	816	81	79	84	E b N	s E	s E	34.70	3.0	Inap.	...	C. C. Str. 10.	Cu. Str. 4.	Cu. Str. 10.
22	29.612	29.612	615	61.6	69.1	51.9	498	564	410	91	79	84	s w b s	s s W	W	123.90	3.0	0.680	...	Rain.	Do. 10.	Clear.
23	853	817	918	53.5	73.6	63.7	348	476	453	86	59	80	W s W	s W	W s W	176.61	2.0	...	...	Clear.	Do. 4.	Do. [thun.
24	903	916	30.004	64.1	76.2	63.0	446	652	510	77	73	88	s s W	s s W	W	81.75	2.5	0.370	...	Do.	Clear.	Cu. Str. 6. dis.
25	925	982	041	62.0	78.6	63.1	498	626	422	91	65	75	W	s s W	s w b w	21.20	1.5	...	...	Do.	Cu. St. 6.	C. C. Str. 8.
29	30.006	30.035	29.951	65.8	83.5	63.7	576	657	471	92	56	81	s	s s E	s b E	20.20	2.0	0.300	...	C. C. Str. 4.	Do. 8.	Clear.
27	29.934	29.840	866	65.0	76.1	65.3	556	652	549	91	73	89	s b W	s s E	s b W	76.00	2.0	Inap.	...	Cu. Str. 10.	C. C. Str. 4.	C. C. Str. 4.
28	838	818	821	62.4	81.2	68.0	466	585	619	85	56	92	s W	s s W	s	64.10	1.5	...	...	Do 10.	Cu. Str. 4.	Cu. Str. 8.
29	865	720	851	63.6	78.6	57.5	543	619	343	94	64	72	s	W	s b W	88.80	1.0	Inap.	...	Rain.	Cirr. 4.	Clear.
30	793	709	898	57.7	77.1	59.1	407	436	387	87	49	79	s s W	s s W	W	62.40	1.5	Inap.	...	Clear.	Cu. Str. 8.	Cu. Str. 10.
31	850	996	992	49.0	68.4	53.2	303	411	328	89	60	83	W	W s W	W s W	198.40	1.5	..	...	Do.	Clear	Clear.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—SEPTEMBER, 1861.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., LL.D.

Latitude—45 deg. 32 min. North. Longitude—73 deg. 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.—F.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Horizontal Movement in Miles in 24 hours.	Mean of Ozone. (tenths)	Rain in Inches.	Snow in Inches.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.					6 A.M.	2 P.M.	10 P.M.
1	30.030	30.017	30.039	49.3	72.2	56.6	297	.365	.368	.85	.47	.81	w s w	w s w	w s w	32.10	2.0	...	...	Clear.	Clear.	Clear. Au. Bo.
2	29.959	29.914	29.851	52.2	68.9	61.0	.376	.502	.473	.87	.72	.88	s E b E	s s w	E b N	44.90	2.5	0.386	...	Cu. Str. 8.	Cu. Str. 4.	Cu. Str. 10.
3	637	720	889	71.0	81.4	63.0	.651	.585	.453	.88	.56	.80	w s w	s s w	s s w	232.10	2.5	...	...	Do. 4.	Do. 4.	Clear. d.t.9.30.
4	882	931	30.021	59.0	65.0	53.7	.358	.307	.315	.73	.51	.77	w	w	w s w	230.60	1.5	...	...	Clear.	Do. 4.	Do. ft. Au. Bor.
5	992	980	29.844	48.6	69.6	55.7	.278	.367	.370	.81	.52	.84	s	s b E	s s E	20.00	2.0	...	...	Do. Frost.	C. C. Str. 4.	Cu. Str. 2.
6	699	477	532	56.1	74.6	60.1	.398	.568	.462	.90	.67	.91	s s E	E s E	E s E	173.76	2.0	0.306	...	Cu. Str. 8.	Cu. Str. 2.	Clear.
7	850	897	902	56.0	72.4	52.0	.370	.550	.289	.84	.69	.76	s s w	s s w	s s w	214.40	1.5	...	...	Do. 4.	Clear.	Do. [Au. Bor.
8	30.090	30.110	30.170	46.5	61.0	50.1	.280	.352	.290	.88	.70	.82	w s w	s w	s w	38.10	1.5	...	...	Clear.	Cu. Str. 4.	Cu. Str. 2. Ft.
9	129	175	150	48.2	68.6	53.0	.285	.349	.305	.85	.51	.77	s	E s E	s E	9.40	1.5	...	...	C. C. Str. 10.	Do. 8.	Clear.
10	198	114	017	51.0	67.7	56.0	.348	.386	.368	.93	.57	.81	E s E	E s E	E	9.80	2.0	...	...	Do. 8.	Clear.	Do.
11	29.833	29.700	29.662	53.3	57.1	54.1	.321	.378	399	.80	.81	.93	N E b N	s s E	N	79.80	2.5	0.156	...	Cu. Str. 10.	Rain.	Cu. Str. 4.
12	624	666	736	52.5	68.4	56.1	.361	.509	.391	.93	.75	.87	s s w	s s w	s s w	132.30	2.0	...	...	Do. 10.	Cu. Str. 4.	Clear.
13	802	804	914	56.1	75.6	63.0	.427	.584	.422	.97	.66	.76	s b E	s	s s E	118.70	2.5	...	...	Fog.	Clear.	Do.
14	912	830	808	60.1	75.2	64.2	.432	.745	.563	.85	.86	.94	s E b E	s E	s E	47.60	2.5	0.066	...	C. C. Str. 4.	Cu. Str. 10.	Rain.
15	700	862	967	68.2	73.6	54.2	.584	.476	.341	.87	.59	.83	s w	w b s	N W	238.10	2.5	...	...	Cirr. 2.	Do. 4.	Clear. Au. Bo.
16	972	30.052	934	41.0	69.6	51.0	.235	.329	.302	.91	.46	.82	s w b w	s s E	s E b E	43.50	1.0	...	...	Clear. Frost.	Clear.	Cu. Str. 10.
17	770	29.799	817	47.5	68.0	52.0	.291	.516	.283	.89	.77	.76	E s E	s s E	s E b E	0.70	1.5	...	...	C. C. Str. 8.	Do.	Clear.
18	799	823	871	46.2	79.6	65.1	.269	.606	.523	.88	.60	.86	N E	s E b E	s E	17.02	1.5	...	...	Cu. Str. 4.	Cu. Str. 10.	Do.
19	714	704	683	61.0	78.4	72.0	.449	.626	.601	.85	.63	.78	s E b E	s s E	E s E	205.10	1.5	...	...	Cirr. Str. 4.	Clear.	Do.
20	842	848	837	57.6	61.7	52.9	.229	.263	.328	91	.48	.83	w s w	s b E	N E b E	42.90	3.0	...	...	C. C. Str. 4.	Cu Str. 10.	Rain.
21	680	660	756	47.0	48.0	45.0	.291	.310	.282	89	.92	.96	N E b E	N E b E	N E b E	518.30	4.0	2.646	...	Rain.	Do. 4.	Do.
22	763	757	770	46.2	51.0	48.8	.286	.302	.303	.92	.82	89	N b w	s E b E	s s w	184.10	3.0	...	...	Cu. Str. 10.	Do. 10.	C. C. Str. 8.
23	610	630	707	47.0	69.5	54.0	.309	.464	.369	.96	.79	.90	s s E	w b s	s s w	44.40	2.5	0.090	...	Rain.	Clear.	Cu. Str. 10.
24	860	904	991	50.0	69.7	51.3	.290	.502	.321	.82	.83	.86	s w	s w	s w b s	109.50	1.5	...	...	Clear.	Do.	Clear. Au. Bo.
25	924	993	845	48.0	64.1	55.0	.310	.314	.376	.92	.53	.87	s s E	s b w	s s E	38.91	1.5	...	...	Fog.	Cirr. 4.	Do.
26	770	750	656	50.1	79.1	65.0	.309	.619	.583	.85	.64	.94	s s E	s s E	s s E	91.80	2.0	...	...	C. C. Str. 8.	Cu. Str. 4.	Cu. Str. 1.
27	590	515	303	58.5	58.7	57.6	.476	.423	.459	.97	.88	97	s s E	s s E	E	205.70	3.5	1.066	...	Rain.	Rain.	Rain.
28	276	540	643	54.3	55.6	51.0	.390	.259	.328	.92	.68	.89	s w b s	w s w	w s w	178.20	3.0	0.100	...	Cu. Str. 10.	Cu. Str. 4.	C. C. Str. 4.
29	999	30.050	30.196	41.1	50.1	38.6	.212	.309	.201	.82	.85	.86	w b s	w b s	s w	157.40	1.5	In'p.	...	Do. 8.	Clear.	Clear.
30	30.270	235	299	40.2	59.0	40.0	.232	.416	.216	.95	.85	.91	s s E	s b E	s b E	8.02	2.0	...	...	Do. 10.	Cu. Str. 4.	Do.
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR AUGUST, 1861.

Barometer	Highest, the 20th day	30.190
	Lowest, the 10th day	29.420
	Monthly Mean	29.853
	Monthly Range	0.770
Thermometer	Highest, the 1st day	90°.0
	Lowest, the 20th day	46°.2
	Monthly Mean	66°.84
	Monthly Range	43°.8

Greatest intensity of the Sun's Rays .... 108°.4
Lowest Point of Terrestrial Radiation .... 41°.7
Amount of evaporation 3.02
Mean of Humidity .... .736
Rain fell on 12 days, amounting to 1.950 inches; it was raining 12 hours and 41 minutes, and was accompanied by thunder on 5 days.
Most prevalent wind, the S. S. W.
Least prevalent wind, the N.
Most windy day, the 14th; mean miles per hour, 9.35.
Least windy day, the 9th; mean miles per hour, 0.42.
Aurora Borealis visible on 4 nights.
Solar Haloes visible on 3 days.
The Electrical state of the Atmosphere has indicated rather high intensity.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR SEPTEMBER, 1861.

Barometer	Highest, the 30th day	30.299
	Lowest, the 28th day	29 276
	Monthly Mean	29.849
	Monthly Range	1.023
Thermometer	Highest, the 18th day	79°6
	Lowest, the 25th day	35°0
	Monthly Mean	58°06
	Monthly Range	44°6

Greatest intensity of the Sun's rays .... 97°8
Lowest point of Terrestrial Radiation .... 32°0
Mean of Humidity .... .804
Amount of Evaporation 1.83
Rain fell on 9 days, amounting to 4.316 inches; it was raining 66 hours and 50 minutes, and thunder was heard on 1 day.
Most prevalent wind, S. S. E.
Least prevalent wind, E.
Most windy day, the 21st day; mean miles per hour, 21.60.
Least windy day, the 17th day; mean miles per hour 0.02.
Aurora Borealis visible on 5 nights. On 2 nights the Magnetic disturbance was considerable during its apparition.
The Electrical state of the Atmosphere has indicated feeble intensity.
First Frost occurred on the 5th day.
Solar Haloes seen on 2 days.

ERRATA.

Page 87, line 5 from bottom, *for* teamway, *read* tramway.
" 188, line 5 from top, *for* resembling, *read* resembles.
" 191, line 14, *for* F R.S, *read* F.G.S.
" 229, line 4 from bottom, *before* exhumed human relics, *insert* the.
" 301, line 5 from bottom, *for* Professor of Mineralogy, *read* Professor of Metallurgy.
" 487, line 26, *for* arranged, *read* surveyed.
" 500, line 3 from bottom, *for* of, *read* or.
" 516, line 10, *erase the word* ambulacral.

INDEX.

SCIENTIFIC AND LITERARY NOTES :

MINERALOGY AND GEOLOGY.

SELECTED ARTICLES AND TRANSLATIONS :

POSTSCRIPT.—Since our remarks on fossil sponges, in the "Minerals and Geology of Canada," page 505, were printed off, we have received a publication of the Geological Survey, containing descriptions of various new species of Lower Silurian Fossils, by E. Billings, F.G.S. In this publication, Mr. Billings describes, under the generic name of *Eospongia*, two sponges recently brought by Mr. Richardson from the Chazy Limestone of the Mingan Islands, together with a third species (*Astylospongia parvula*) from the Trenton Limestone of Ottawa City. These, however, as compared with the generality of Silurian fossils, may be looked upon as quite of exceptional occurrence. Nevertheless, to prevent misconception, the reader is requested to alter the words "determinate forms." page 505, line 16, into "characteristic forms."—E. J. C.

TORONTO: PRINTED BY LOVELL AND GIBSON.

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